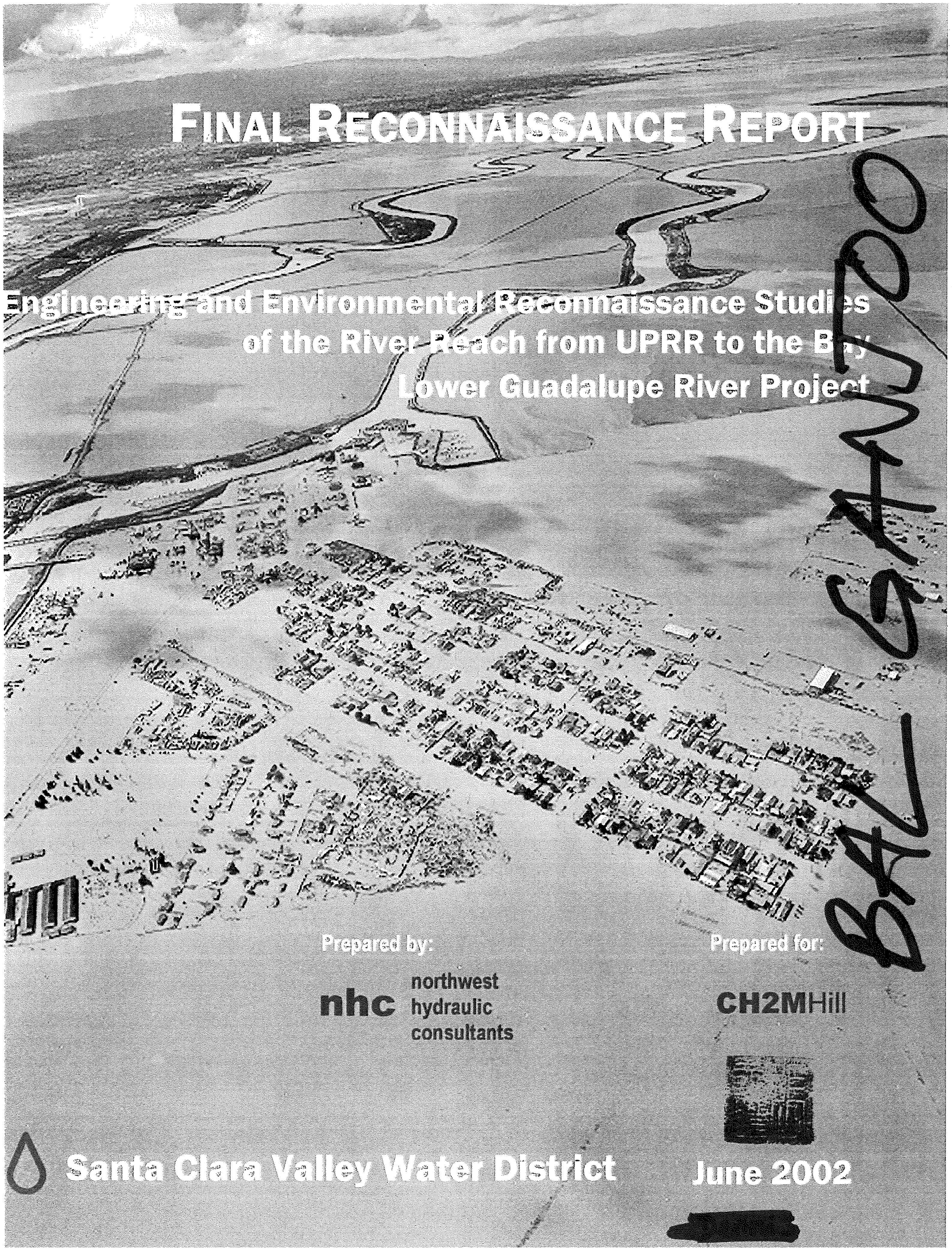

FINAL RECONNAISSANCE REPORT

Engineering and Environmental Reconnaissance Studies of the River Reach from UPRR to the Bay
Lower Guadalupe River Project

BAL GANDO

Prepared by:

nhc northwest hydraulic consultants

Prepared for:

CH2MHill

Santa Clara Valley Water District

June 2002

[redacted]

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June 28, 2002

Mr. David Von Rueden
CH2Mhill
1737 N. First Street, Suite 300
San Jose, CA 95112

REG: "Final Combined Baylands Reconnaissance Report and Technical Memoranda" for the LGR Flood Protection Planning Studies, NHC Project. No 50198.10

Dear Mr. Von Rueden:

Enclosed are two camera-ready copies of the Baylands Study binders containing the "Final Combined Baylands Reconnaissance Report and Baylands Technical Memoranda" prepared for the Lower Guadalupe River Flood Protection Planning Studies. Northwest Hydraulic Consultants completed the original Draft Reconnaissance Study Report in June 2000 and received review comments from the Water District in the fall of 2000. Shortly thereafter, additional technical issues and questions regarding how the LGR and Baylands study areas would respond to a design flood event on the LGR were raised. Additional analyses of the hydraulic performance characteristics of the Baylands and LGR study reaches were required to address these new questions. During the period October 2000, through June 2002, more than twenty two additional Baylands analysis studies were completed in order to address project design and systems response questions raised by various reviewers of the overall LGR Flood Control Project. Results for each of the significant Baylands studies were documented in the form of a Technical Memorandum.

Copies of all of the Baylands Technical Memoranda along with the Final Baylands Reconnaissance Study Report are bound into a comprehensive Baylands Study Binder for your files. Two camera-ready copies are enclosed. The Baylands Technical Memoranda are listed chronologically from the most recent to the oldest, and the Final Baylands Reconnaissance Study Report (as it was originally scoped) is attached.

Please call me if you have any questions regarding these materials.

Sincerely,
NORTHWEST HYDRAULIC CONSULTANTS, Inc.

Robert C MacArthur

Robert C. MacArthur, Ph.D., P.E.
Principal

Enclosures: Two camera-ready Baylands Study Binders

RECENT TECHNICAL MEMOS

Chronology of technical memorandums or other significant baylands submittals subsequent to the Draft Reconnaissance Study Report:

22. 5 June 2002 Final Technical Memorandum
21. 30 April 2002 Technical Memorandum
20. 11 April 2002 Memorandum
19. 4 April 2002 Memorandum
18. 27 February 2002 Technical Memorandum
17. 11 January 2002 Email Addendum
16. 3 January 2002 Memorandum
15. 7 December 2001 Transmittal
14. 13 November 2001 Memorandum
13. 29 October 2001 Email Transmittal
12. 11 July 2001 Email Transmittal
11. 5 July 2001 Technical Memorandum
10. 26 June 2001 Email Transmittal
9. 31 May 2001 Memorandum
8. 24 May 2001 Memorandum
7. 8 May 2001 Memorandum
6. 30 April 2001 Memorandum
5. 11 April 2001 Memorandum
4. 27 February 2001 Memorandum
3. 11 December 2000 Memorandum
2. 13 November 2000 Memorandum
1. 23 October 2000 Memorandum

Technical Memorandum—Final

Northwest Hydraulic Consultants
3950 Industrial Boulevard, Suite 100c
West Sacramento, CA 95691
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Date: **June 3, 2002** **NHC Project: 50198 LGR**

To: David Von Rueden, PE

Company/Agency: CH2M HILL, San Jose

From: Robert MacArthur, PE

Subject: Evaluation of Effects of Interior Drainage Flows on LGR Hydraulic Conditions—Tech Memo

REGISTERED PROFESSIONAL ENGINEER
Robert C. MacArthur
No. 33283
Exp. 6-30-04
CIVIL
STATE OF CALIFORNIA

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Evaluation of Effects of Interior Drainage Flows on LGR Hydraulic Conditions—Technical Memo

Study Purpose

This memorandum summarizes the results of a hydrologic assessment of interior drainage contributions to the Lower Guadalupe River (LGR) downstream of I-880 and the hydraulic effects of interior stormwater drainage discharges into the LGR during the design flood event. The 6.7-mile project reach of the Guadalupe River lies between Interstate I-880 and the Union Pacific Railroad (UPRR) Bridge at Alviso. The study investigated changes in water surface elevation along the project reach when flows from local stormwater drainage facilities downstream of I-880 are combined with river flows expected to occur during a design (100-year) flood event, as defined by the United States Army Corps of Engineers (USACE). Floodplain mapping and interior flooding analyses were not part of this investigation.

Figure 1 shows the approximate extent of the study area and City of San Jose watershed boundaries for contributing interior areas draining into the Guadalupe River downstream of I-880. Figure 2 shows the study area and City of Santa Clara watershed boundaries for contributing interior areas draining into the Guadalupe River downstream of I-880. Figure 3 shows the approximate inlet locations of pumped flows entering the LGR from both sides of the river. Pump stations included explicitly in this study are highlighted in the figure. Station locations not highlighted were not explicitly included because they were estimated to contribute a small percentage (on the order of 10 percent or less) of the total likely discharge from all contributing pumping facilities downstream of I-880. Figure 4 shows the approximate locations of the six large gravity outfalls assumed to contribute the most gravity drainage occurring during a design event. These most significant outfalls are all greater than 36 inches in diameter and are located at elevations that allow them to discharge into the river during the design event. Those outfalls that are not included in these analyses either become submerged with flapgates closed during the design event so they can not discharge into the river, or they were so small (less than 36-inch diameter) as to contribute an insignificant amount to the total likely discharge from all contributing gravity outfalls downstream of I-880. All of the City of Santa Clara direct pumping and gravity outfalls to Guadalupe river, downstream of Interstate 880, were included in these analyses. Only one 30-inch diameter storm drain that discharges into a City of San Jose storm system near the airport, before discharging into the river, was not analyzed or included. The estimated sum of the pumps and gravity drains omitted from the San Jose side of the river (including the proposed future pump station modification (50 cfs) at the San Jose International Airport) is approximately 414 cfs.

A hydraulic sensitivity assessment was conducted to determine the effects of adding all of these minor flows (444 cfs total) to the river at each inlet location, assuming that the pumps were discharging at maximum capacity. This is a conservative assumption, because the pumping peaks will most likely not coincide with the river peak discharge, as explained further on in this report. The sensitivity analysis indicated that the computed river water surface elevation at the peak of the design event increases by one inch or less throughout most of the study area, with a maximum increase in elevation of approximately 2.75 inches between river stations 9+810 to

10+170. Therefore, the net effect of adding the minor drains and pumps that were omitted does not have a significant impact on the computed water surface profile.

Table 1 summarizes the river station locations and discharges from the fourteen pumps and gravity outfalls considered in the study. Contributions from interior drainage facilities upstream of I-880 to Los Gatos Creek were not considered in this investigation. However, it is unlikely that significant local runoff enters the Guadalupe River downstream of St. John's Street gauge, before I-880. There are no pump stations in this reach and the gravity drains are likely to be affected (with possible flap gate closures) by high water conditions during bank-full flow in the river. The area downstream of the UPRR Bridge at Alviso is referred to as the Baylands and is outside the LGR Project reach. The LGR flows to the Bay through the Baylands. Therefore, an analysis was also conducted to evaluate potential effects of these cumulative river and interior drainage flows on water surface elevations along Alviso Slough and to ponding depths in the salt ponds adjacent to the slough.

Scope of Work

The scope of work for this study includes the following tasks:

- Review details regarding the storm sewer systems for the Cities of San Jose and Santa Clara, including their stormwater pumping and gravity outfall facilities. Select the most significant stormwater and gravity outfall facilities likely to contribute stormwater to the LGR during a design event downstream of I-880.
- Develop pump discharge and gravity outfall hydrographs for USACE 100-year, 72-hour rainfall event for each of the fourteen selected inlet locations shown in Figure 3 and Figure 4
- Review existing HEC-RAS model of LGR including cross-section geometries, bridge elevations, water surface profiles, and flow data
- Add pump discharge and gravity outfall flows to the HEC-RAS model at points of inflow into the Guadalupe River
- Test model stability and evaluate general model performance
- Develop and compare water surface profiles and velocities associated with the following flood scenarios:
    1. The 100-year USACE flood hydrograph alone, with no interior drainage facility (facility) discharges
    2. The cumulative effect of the 100-year USACE flood hydrograph and facility discharge hydrographs added together (referred to as the *Cumulative Effects of River Flows and Interior Drainage* modeling scenario)
    3. The effect of lagging the total facility discharge hydrograph such that its peak aligns (coincides) with the peak of the 100-year USACE flood hydrograph (referred to as the *Coincident Peak* modeling scenario)
- Investigate the sensitivity of computed water surface profiles to local floating debris jams at bridges

- Evaluate changes in water surface profiles and depths of ponding in the Baylands resulting from the *cumulative effects* scenario (second scenario above)
- Prepare a technical memorandum summarizing the approach and results from this investigation.
- Meet with District to discuss findings
- The study of gravity outfalls upstream of I-880 was not in the scope for this study.
- Floodplain mapping and interior flooding analyses were not part of this investigation.

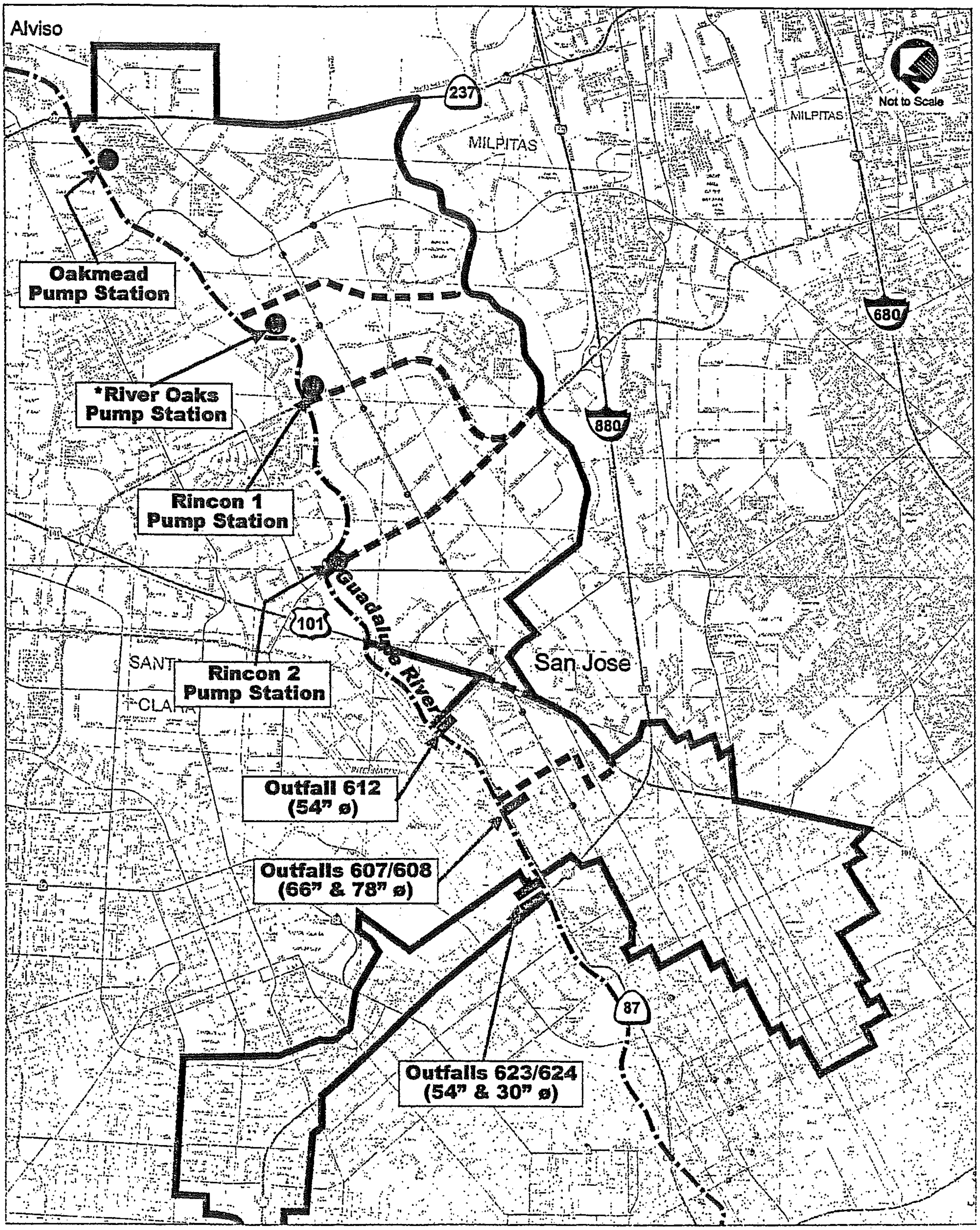

Figure 1
City of San Jose Local Drainage Boundaries
Lower Guadalupe River Project

*River Oaks Pump Station not included in this study.

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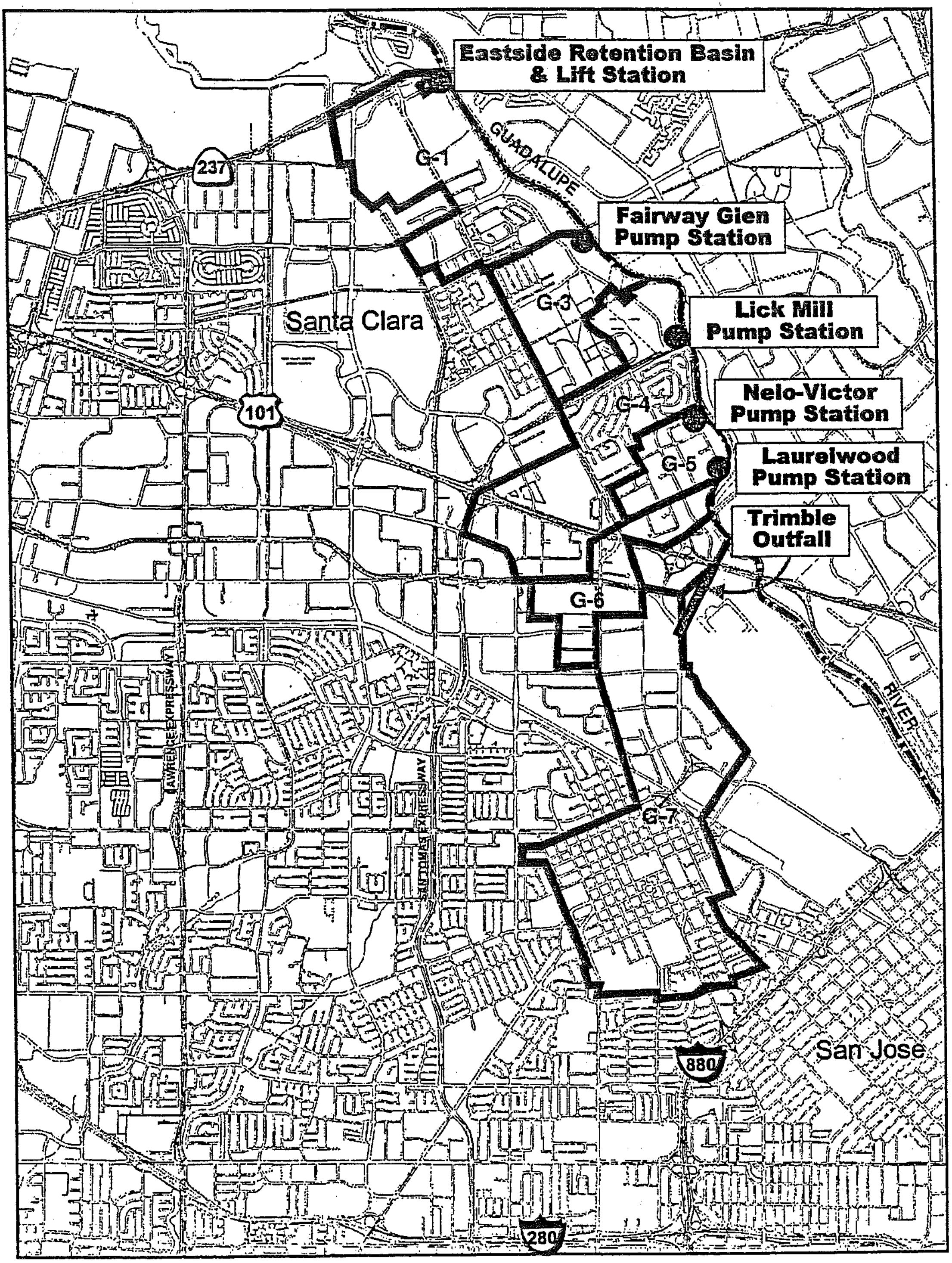

Figure 2
City of Santa Clara Local Drainage Boundaries
Lower Guadalupe River Project

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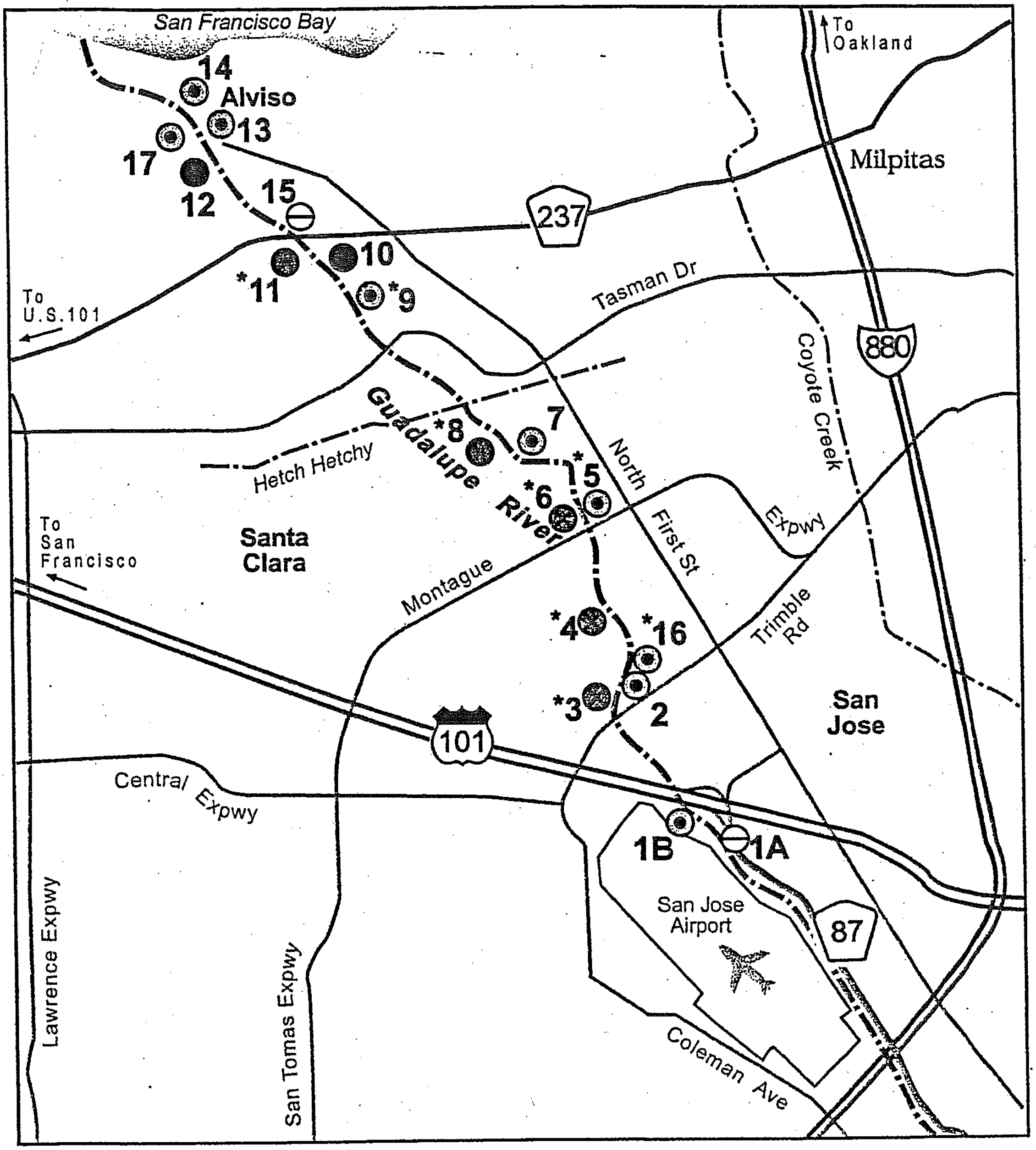

Pump Stations

1A	Airport Parkway Station (10.5 cfs)
1B	Airport (50 cfs)
2	Gateway (7 cfs)
* 3	Laurelwood & Victor (130 cfs)
* 4	Nelo & Victor (110 cfs)
* 5	Rincon 1 (360 cfs)
* 6	Lick Mill (230 cfs)
7	River Oaks (67 cfs)
* 8	Fairway Glen (170 cfs)
* 9	Oakmead (670 cfs)
10	Oakcrest Estates (12 cfs)
*11	East Side (100 cfs)
12	Summerset (21 cfs)
13	Alviso Pump Station 12 (0.2 cfs)
14	Elizabeth & Gold St. (45 cfs)
15	N. First Street (72 cfs)
* 16	Rincon 2 (600 cfs) (Proposed)
17	Alviso Pump Station 13

Ownership

⊙ City of San Jose
▨ City of Santa Clara
⊖ Caltrans
● Private

* = Pump Stations included in this report.

Figure 3
Approximate Locations of Pump Stations
Lower Guadalupe River Project

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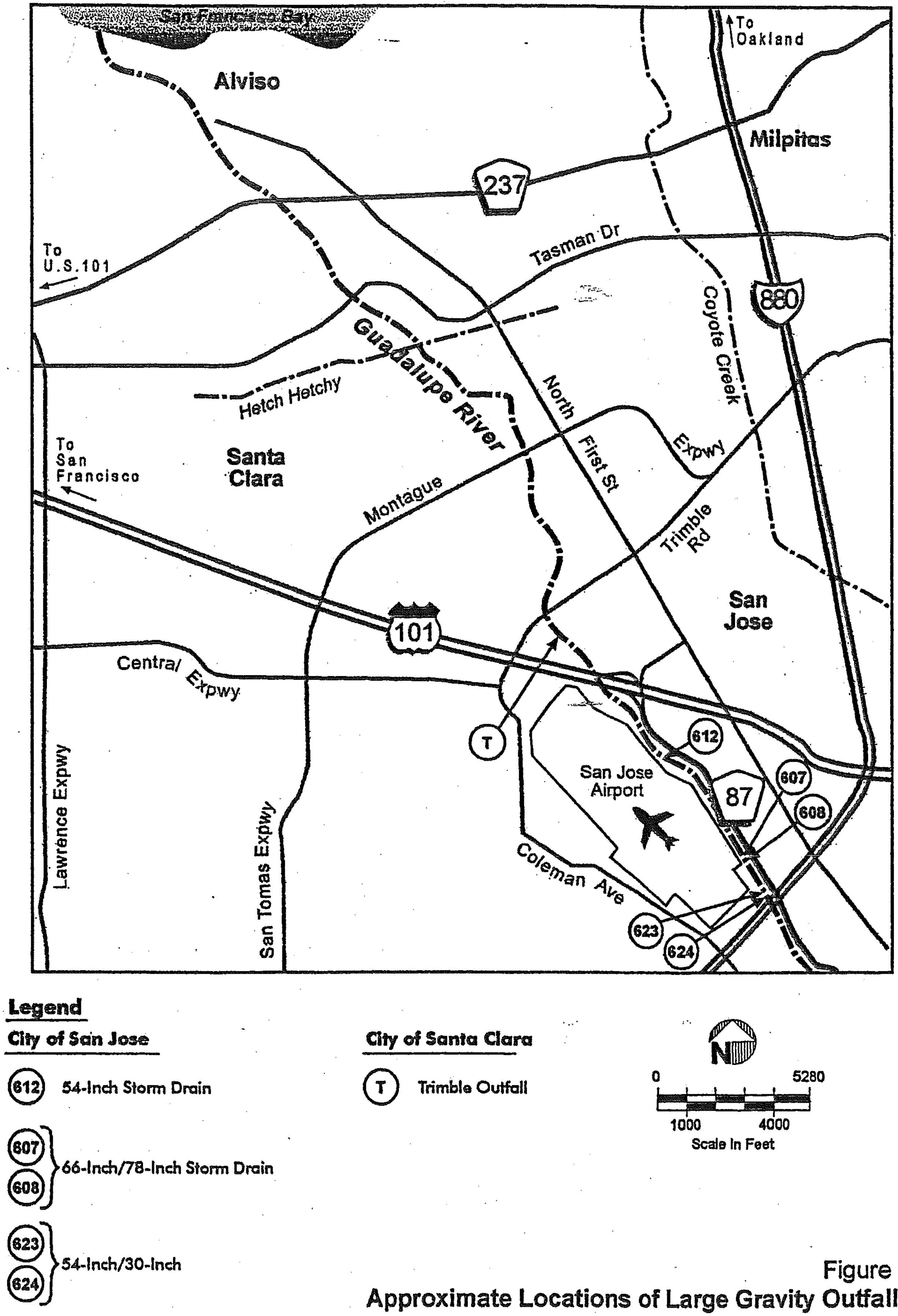

Figure 4
Approximate Locations of Large Gravity Outfalls
Lower Guadalupe River Project

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Structure of Memo

A summary of the overall study findings and brief descriptions of the data, assumptions and methods used to develop these results are summarized below. Appendices A and B provide detailed summaries of the findings, data, assumptions, and methods used to estimate interior drainage volumes, pumped flows, and gravity outfall contributions to the LGR during the occurrence of a 100-year, 72 hour regional storm event as defined by the USACE.

Summary of Findings

Interior Drainage Facility Discharges. Table 1 presents the pump and gravity outfall discharges for the fourteen pump and gravity outfalls added to the "with-project" HEC-RAS model. The column entitled "Discharge during 17k Flood Hydrograph Peak" lists the discharges from each pump or gravity drain facility at the moment the peak of the design flood hydrograph passes through the reach. These discharges were added to the USACE's 17,000-cubic-feet-per-second (cfs) flood at their respective cross section stations to develop the Cumulative Effects of River Flows and Interior Drainage modeling scenario. The "Discharge at Facility at Cumulative Peak" column in Table 1 lists the individual pump or gravity drain facility discharges occurring at the time when the cumulative hydrograph for all fourteen facilities reaches its peak. These were added to the 17,000-cfs flood flow to develop the Coincident Peak modeling scenario. This coincident peak scenario considers the possibility that the interior drainage flows may be lagged by about eight hours because of a storm cell delay or a second cell's appearance over the drainage area. It can be viewed as a worst-case scenario, for comparison purposes, in which the peak of the flood hydrograph coincides with the peak of the cumulative facility discharge hydrograph.

Development of Model Flows and Hydrographs. The total contribution from the interior drainage facilities occurring at the time of the peak of the design flood hydrograph was calculated to be 1,325 cfs. The peak of the cumulative facility discharge hydrograph was calculated to be 3,027 cfs. Adding these discharges to the 17,000-cfs peak of the flood hydrograph results in estimated total discharges of 18,325 cfs (cumulative peak near UPRR at Alviso) and 20,027 cfs (coincident peak near UPRR at Alviso) for the two modeling scenarios, respectively. See Figure 5 and Figure 6 for these results.

The instantaneous pumping discharges presented in Table 1 were added to the steady-state HEC-RAS model as inflows at cross sections nearest to the facility's actual location. A cumulative hydrograph from the fourteen discharge facilities was developed and plotted together with the 100-year, Guadalupe River flood hydrograph in Figure 5. These two hydrographs were then added together to produce the *Cumulative Effects* of River Flows and Interior Drainage Hydrograph also presented in Figure 5. The peak discharge resulting from this scenario is 18,325 cfs near UPRR Bridge at Alviso.

The peak discharges from the cumulative facility discharge and USACE 100-year flood hydrographs occur at hours 36.75 and 45, respectively (Figure 5). Thus, the maximum facility discharge into the river develops about eight hours before the peak of the river hydrograph. A worst-case scenario hydrograph was developed by lagging the cumulative facility discharge hydrograph by 8.25 hours so the two hydrograph peaks align at the same time. This coincident peak hydrograph is presented in Figure 6. The peak discharge resulting from this scenario is 20,027 cfs near the UPRR Bridge.

Table 1. Pump Station and Gravity Outflow Discharges Downstream of I-880

Facility	Cross Section Station (*P*-line)	Discharge during 17k Flood Hydrograph Peak, cfs(1)	Discharge at Each Facility at Cumulative Peak, cfs(2)	Maximum Discharge During Event, cfs	Data Source
100-year Flood Hydrograph	17+612	17,000	17,000	17,000	USACE
2 Gravity Outfalls 623 and 624	17+580	107	205	205	A-N West
2 Gravity Outfalls 607 and 608	16+710	172	510	510	A-N West
1 Gravity Outfall 612	15+670	33	110	110	A-N West
Trimble Outfall	14+010	166	280	280	Schaaf & Wheeler
Pump Station Rincon2	13+500	120	468	474	A-N West
Pump Station Laurelwood	13+260	132	132	132	Schaaf & Wheeler
Pump Station Nelo-Victor	12+510	56	112	112	Schaaf & Wheeler
Pump Station Rincon1	11+807	79	242	242	A-N West
Pump Station Lickmill	11+760	156	234	234	Schaaf & Wheeler
Pump Station Fairway Glen	10+110	83	166	166	Schaaf & Wheeler
Pump Station Oakmead	8+640	120	468	474	A-N West
Pump Station Eastside	8+056	101	101	101	Schaaf & Wheeler
Total Discharge Entering Alviso Slough DS of UPRR	7+090	18,325	20,027	20,039	NHC

(1) Values used to develop the *Cumulative Peak Scenario*

(2) *Values* used to develop the *Coincident Peak Scenario*

Modeled Water Surface Profiles and Velocities. The water surface profiles generated from the USACE's 100-year flood alone and 100-year flood combined with the cumulative and coincident facility discharges were plotted from station 6+000 to 12+000 in Figure 7 and stations 12+000 to 17+612 in Figure 8. Flood depths below station 6+000 were essentially the same for all three scenarios because of west levee overtopping and spill into pond A8 at that location. The numerical modeling results are summarized in Table 2 and Table 3 for the cumulative and coincident peak flood plus pumping scenarios.

Table 2. Results from the Cumulative Effects of River Flows and Interior Drainage Modeling Scenario

Bridge	Approximate Station *P*-Line	Water Surface Elevations				Velocity fps	Lowest Elevation of Bridge		
		17k only, m	w/ Facility Discharges, m	Difference			Elev m	Submergence	
				m	ft			m	ft
I880	17+612	17.88	17.91	0.03	0.10	-	-	-	-
Skyport	16+282	14.65	14.70	0.05	0.16	7.22	16.10	-	-
Airport	15+683	13.07	13.11	0.04	0.13	11.29	12.97	0.14	0.46
Parking	14+694	11.42	11.48	0.06	0.20	10.37	12.95	-	-
US101	14+528	11.11	11.18	0.07	0.23	11.35	11.01	0.17	0.56
Trimble	13+700	9.76	9.84	0.08	0.26	8.23	9.84	-	-
Montague	11+825	8.24	8.42	0.18	0.59	6.63	7.60	0.82	2.69
Tasman	9+241	6.36	6.52	0.16	0.52	5.97	6.55	-	-
E237	8+043	5.59	5.72	0.13	0.43	7.41	6.41	-	-
W237	8+010	5.50	5.62	0.12	0.39	6.89	6.40	-	-
Gold St	7+116	4.90	5.01	0.11	0.36	6.56	5.08	-	-
UPRR	7+004	4.86	4.98	0.12	0.39	5.61	4.99	-	-

Table 3. Results of the Coincident Peaks Modeling Scenario

Bridge	Approximate Station *P*-Line	Water Surface Elevations				Velocity fps	Lowest Elevation of Bridge		
		17k only, m	w/ Facility Discharges, m	Difference			Elev m	Submergence	
				m	ft			m	ft
I880	17+612	17.88	17.93	0.05	0.16	-	-	-	-
Skyport	16+282	14.65	14.77	0.12	0.39	7.15	16.10	-	-
Airport	15+683	13.07	13.21	0.14	0.46	11.22	12.97	0.24	0.79
Parking	14+694	11.42	11.65	0.23	0.75	10.53	12.95	-	-
US101	14+528	11.11	11.36	0.25	0.82	11.22	11.01	0.35	1.15
Trimble	13+700	9.76	9.95	0.19	0.62	8.23	9.84	0.11	0.36
Montague	11+825	8.24	8.68	0.44	1.44	6.50	7.60	1.08	3.55
Tasman	9+241	6.36	6.75	0.39	1.28	5.87	6.55	0.20	0.66
E237	8+043	5.59	5.91	0.32	1.05	7.09	6.41	-	-
W237	8+010	5.50	5.81	0.31	1.02	6.56	6.40	-	-
Gold St	7+116	4.90	5.14	0.24	0.79	6.23	5.08	0.06	0.19
UPRR	7+004	4.86	5.10	0.24	0.79	5.35	4.99	0.11	0.36

Modeling results reveal that submergence of the lowest portion (elevation) of the bridge deck (soffit) occurs at three of the twelve bridges in the project area during the cumulative effects scenario and at seven of the twelve bridges during the coincident peaks scenario. Figure 9 through Figure 19 present the water surface elevations generated by the HEC-RAS model at each of the twelve bridges in the study area. Figure 14 clearly shows that the Montague Expressway Bridge is deeply submerged and pressurized, even without contributions from interior drainage facility discharge inflows and becomes more submerged (2.69 and 3.55 feet) with the addition of interior drainage flows. The bridges at Highway 101, Trimble Road, Gold Street, and the Union Pacific Railroad are all very close to pressurizing during the simulations. The lowest soffit elevation used for the Tasman Road Bridge is the low chord of the VTA-LRT bridge, located between the east and west bound vehicle bridges.

The computed water surface elevation at the downstream face of the Interstate 880 bridge is calculated to be 17.88 meters when applying only the 100-year USACE flood (no interior drainage). The water surface elevation at the bridge increases to 17.91 and 17.93 meters for the cumulative discharge and coincident peaks scenarios, respectively due to the addition of interior drainage flows entering Reach A, downstream of I-880. It should be noted that all three water surface elevations are slightly above the 17.86-meter project design criteria for the downstream face of the bridge.

The maximum channel velocities at the bridges for the two modeled scenarios range between 5.4 and 11.4 feet per second (fps) (see Table 2 and Table 3). Bridges with velocities exceeding 7 fps indicate areas where significant channel scour is likely to occur. In addition, such high velocities through bridges tend to dissipate huge amounts of energy if the jet is not directly aligned with the downstream channel. This may cause upstream water surface elevations to increase higher than would be predicted by the one-dimensional model.

Debris Jam Sensitivity Analysis. A sensitivity analysis was performed to determine potential effects of floating debris jams that could occur at the upstream face of bridges during a large flood event. Results from this analysis are intended to identify bridges that are most sensitive to floating debris loading and to demonstrate the importance of long-term river maintenance and the need for flood fighting capacity at LGR bridges. The analysis was accomplished by lowering the low chords of each bridge by two feet to simulate blockage from floating debris. The resulting water surface elevations increased by between 0.13 and 0.58 meters (0.4 and 1.9 feet) at the bridges. This simplified method of estimating the effects of debris jams resulted in most bridges becoming pressurized. The results of the debris sensitivity analysis are summarized in Table 4. The three bridges most affected by the effects of floating debris are Airport Parkway, Parking Lot, and US 101. The results indicate that during high levels of floating debris loading, the bridges in the study area are unlikely to be overtopped, but are likely to require emergency debris removal during significant flood events.

Table 4. Profile Differences Generated by Lowering Bridge Chords Two Feet to Simulate Debris Jams

Bridge	Cumulative Discharge Profile				Coincident Peaks Profile			
	No Debris	Debris	Difference		No Debris	Debris	Difference	
	m	m	m	ft	m	m	m	ft
Skyport	14.65	14.78	0.13	0.43	14.65	14.88	0.23	0.75
Airport	13.07	13.47	0.40	1.31	13.07	13.65	0.58	1.90
Parking	11.42	12.01	0.59	1.94	11.42	12.24	0.82	2.69
US101	11.11	11.69	0.58	1.90	11.11	11.92	0.81	2.66
Trimble	9.76	10.01	0.25	0.82	9.76	10.21	0.45	1.48
Montague	8.24	8.53	0.29	0.95	8.24	8.81	0.57	1.87
Tasman	6.36	6.58	0.22	0.72	6.36	6.88	0.52	1.71
E237	5.59	5.79	0.20	0.66	5.59	6.16	0.57	1.87
W237	5.50	5.70	0.20	0.66	5.50	5.93	0.43	1.41
Gold St	4.90	5.14	0.24	0.79	4.90	5.31	0.41	1.35
UPRR	4.86	5.03	0.17	0.56	4.86	5.18	0.32	1.05

The Highway 101 Bridge is the most sensitive to debris jamming. A simulation in which the low chord of only the Highway 101 bridge was lowered two feet resulted in local water surface increases of about 1.6 feet upstream of the bridge.

Modeling Methodology and Assumptions

Hydraulic Model Description. The hydraulic model used in this study was HEC-RAS Version 3.0 developed by the Hydrologic Engineering Center (HEC) of the USACE. HEC-RAS 3.0 is a one-dimensional, open-channel flow model that can analyze both steady and unsteady flows. For reasons of consistency with previous Guadalupe River modeling efforts, this study was performed using only the steady-state capability of HEC-RAS.

One-dimensional models are capable of calculating only the average flow depth and velocity at river cross sections. They cannot evaluate flow retardation or energy loss due to turbulence or local eddy formation. Energy loss in HEC-RAS is approximated using the Manning equation and a Manning coefficient, or Manning's *n*, which is a lumped energy loss and turbulence parameter applied at each cross section. In HEC-RAS, multiple Manning coefficients can be defined along the length of a cross section to model lateral changes in roughness resulting from channel geometry, bed material characteristics and vegetation. Values for Manning's *n* used in this particular study ranged from 0.027 to 0.030 in the main channel and 0.030 to 0.080 in the flood plains.

Cross Sections and Bridge Data. The cross sections and bridge geometries used in this study were obtained from an earlier baseline conditions HEC-RAS model of the Guadalupe River developed by Northwest Hydraulic Consultants for the Lower Guadalupe River Flood Control Project. The baseline model was calibrated to observed high water elevations in the Guadalupe River that occurred during the 1995 flood event. A total of 367 sections are included in the 6.7-mile reach. The low chord data for the bridges in the model correlated well with the latest survey data obtained from CH2MHill (February 2001), typically within a 0.05- to 0.10-meter tolerance. An exception was the Skyport Bridge model data, which was approximately 0.7 meters lower than the latest survey. This did not affect any previous HEC-RAS studies since the low chord of the bridge in both data sets was well above all flood water surface elevations. The model data for Skyport Bridge in this study was adjusted to match the new survey data.

Boundary Conditions. The downstream boundary condition used for all simulations discussed in this report is based on the 10-year maximum tide elevation of 3.1 meters NAVD 88 with spill occurring over the west Alviso Slough levee into pond A8. The upstream boundary condition at I-880 is 17,000 cfs, which represents the peak of the 100-year USACE hydrograph. Lateral inflows representing drainage pump discharges and gravity outfalls are added to the model at the cross section locations listed in Table 1. The hydrographs for each of the 14 facilities were prepared by A-N West, Inc., and Schaaf and Wheeler. Detailed summaries of their data, assumptions, methods, and findings are reported in Appendices A and B.

Present-Day Conditions Were Assumed for all Interior Drainage Facilities. This study assumed present-day conditions for all of the Interior Drainage Facilities considered herein. Contributions from interior drainage facilities upstream of I-880 to Los Gatos Creek were not considered in this investigation and it is assumed that no additional facilities or improvements that contribute significant flow to the river will be added. One exception, however, is the Rincon 2 pump station which is included in these analyses even though it is not constructed yet, but is completely designed and slated for construction soon. Other future improvements not explicitly included in this study are upgrades planned for the City of Santa Clara's Laurelwood and San Jose International Air Port pump stations. The potential effects of these improvements were considered, however, through a sensitivity analysis. The hydraulic sensitivity assessment was conducted to determine the effects of adding all of the minor gravity flows and possible pump improvements (444 cfs total) we are aware of at this time that were not previously included. These flows were added to the river at each inlet location, assuming that the pumps were discharging at maximum capacity. This is a conservative assumption, because the pumping peaks will most likely not coincide with the river peak discharge, as explained further on in this report. Results from the sensitivity analysis indicated that the computed river water surface elevation at the peak of the design event increases by one inch or less throughout most of the study area, with a maximum increase in elevation of approximately 2.75 inches between river stations 9+810 to 10+170. Therefore, the net effect of adding the minor drains and pumps that were omitted does not have a significant impact on the computed water surface profile.

Figure 5. Cumulative Effects of River Flows and Interior Drainage Hydrograph Development

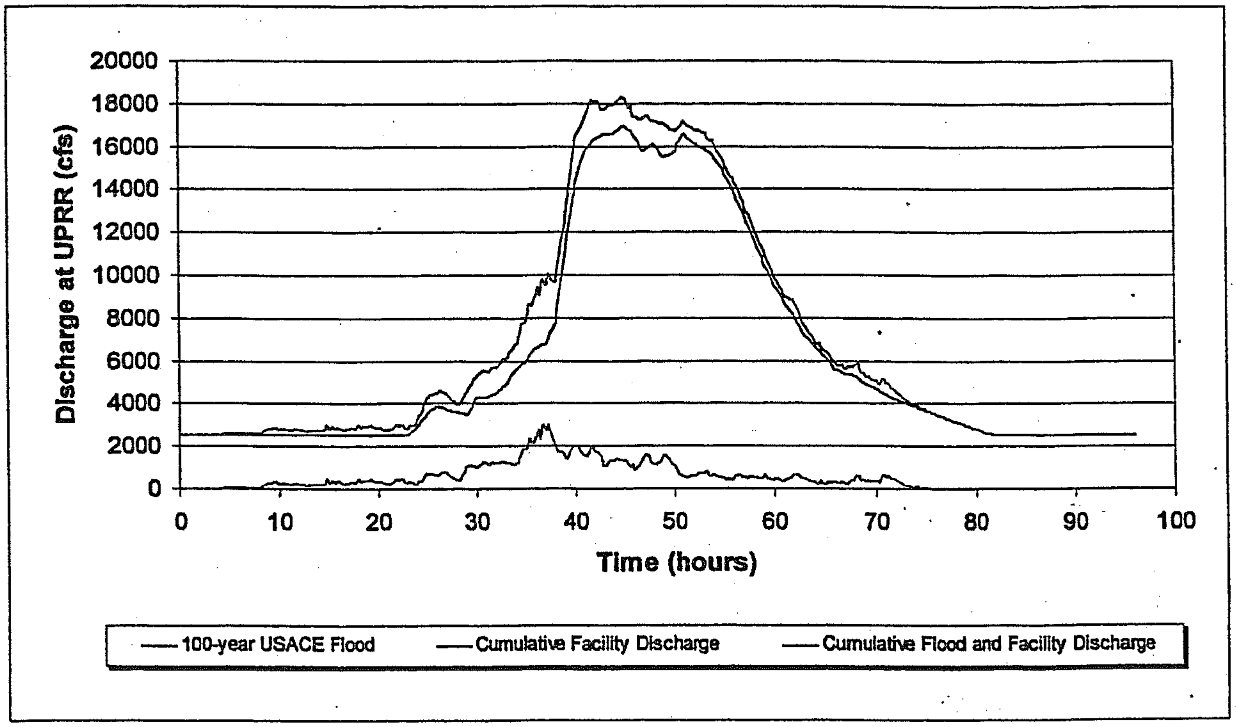


Figure 6. Coincident Peaks Hydrograph Development

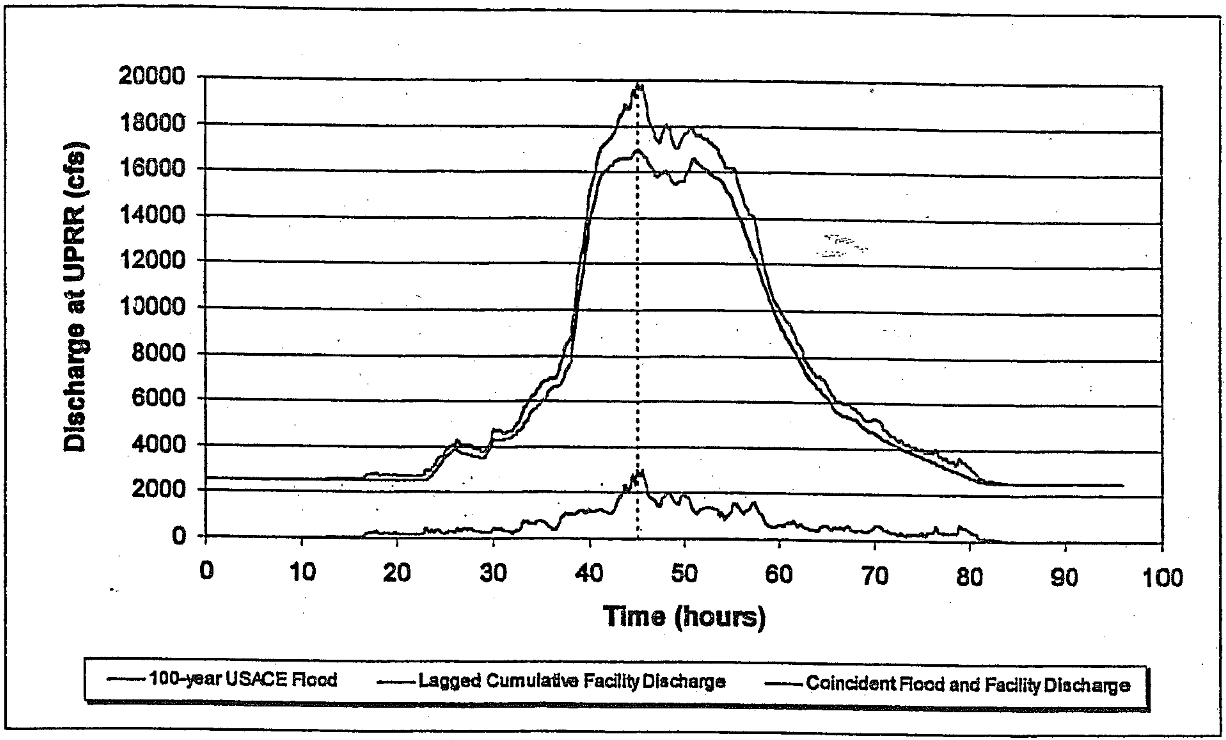


Figure 7. Guadalupe River Water Surface Profiles (Stations 6+000 to 12+000)

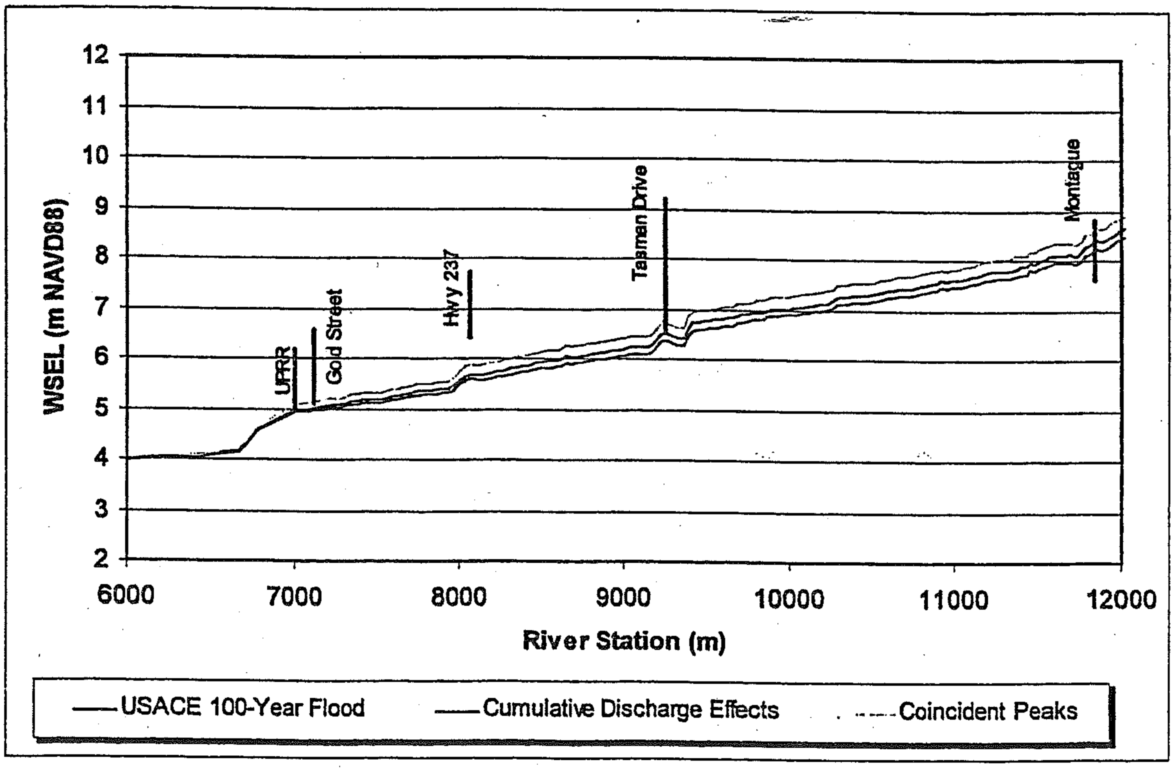


Figure 8. Guadalupe River Water Surface Profiles (Stations 12+000 to 17+612)

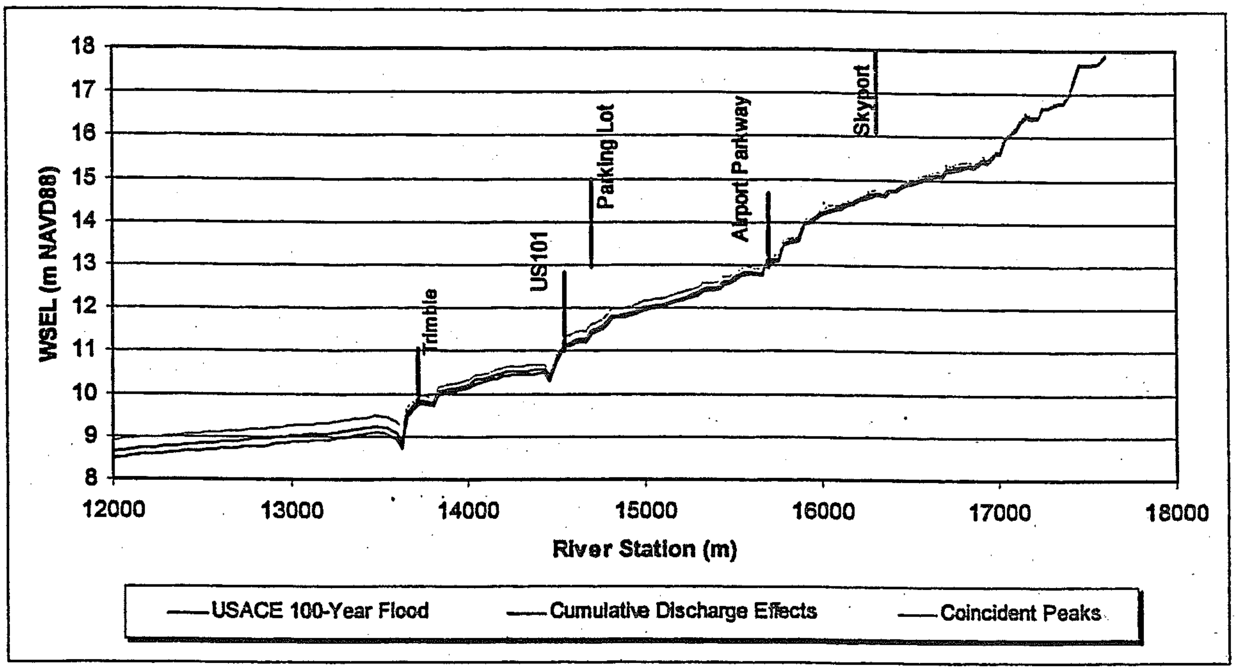


Figure 9. Water Surface Elevations at Skyport Drive Bridge

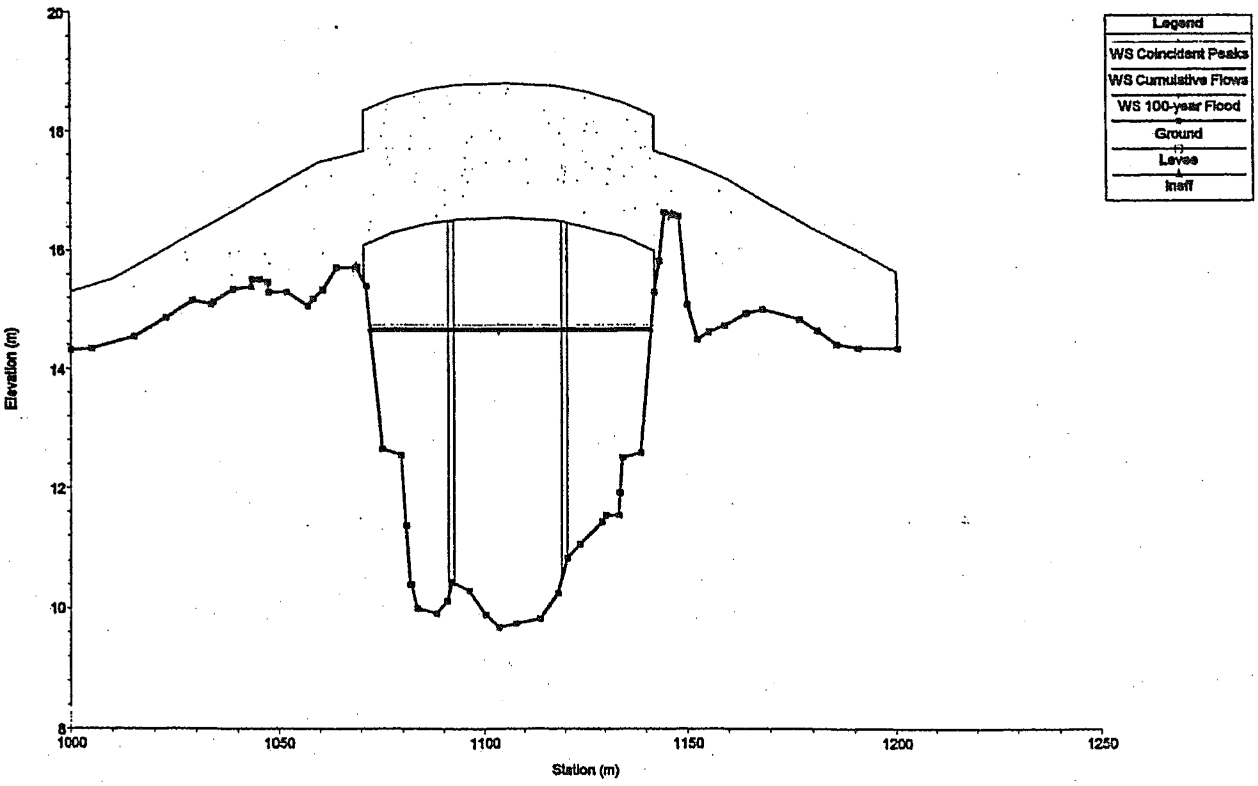


Figure 10. Water Surface Elevations at Airport Parkway Bridge

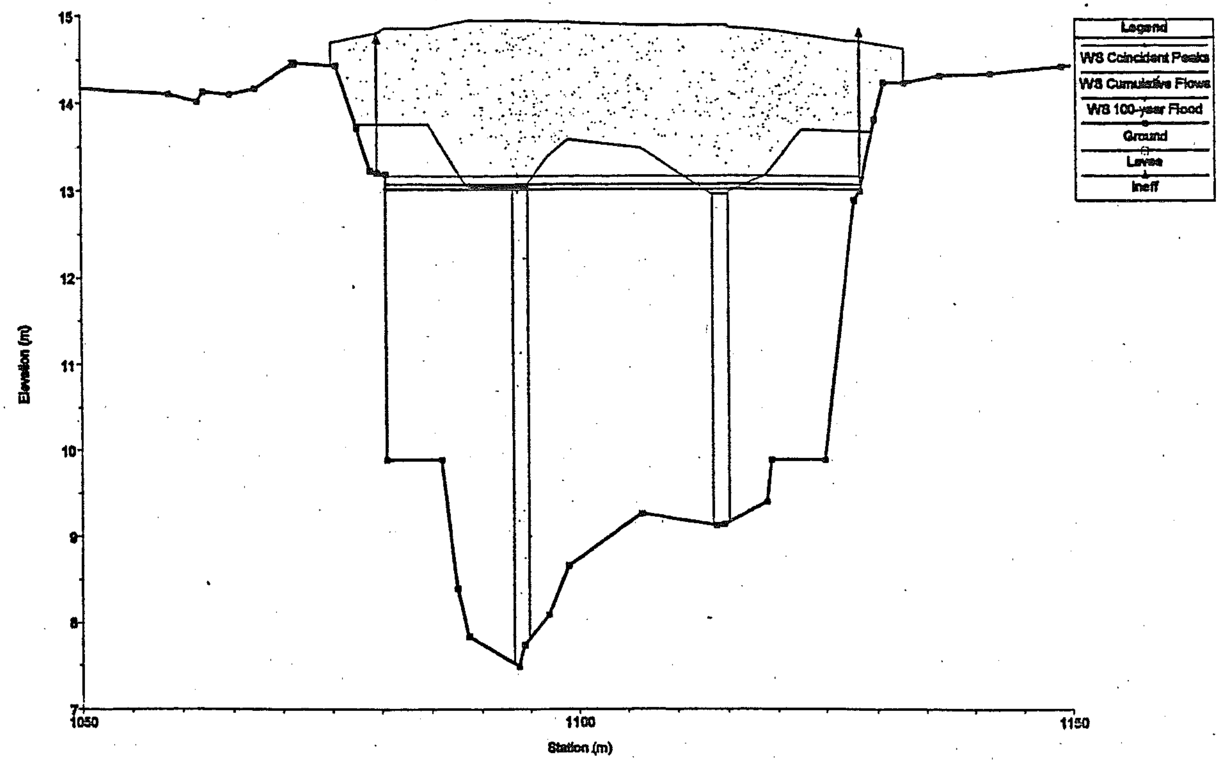


Figure 11. Water Surface Elevations at Parking Lot Bridge

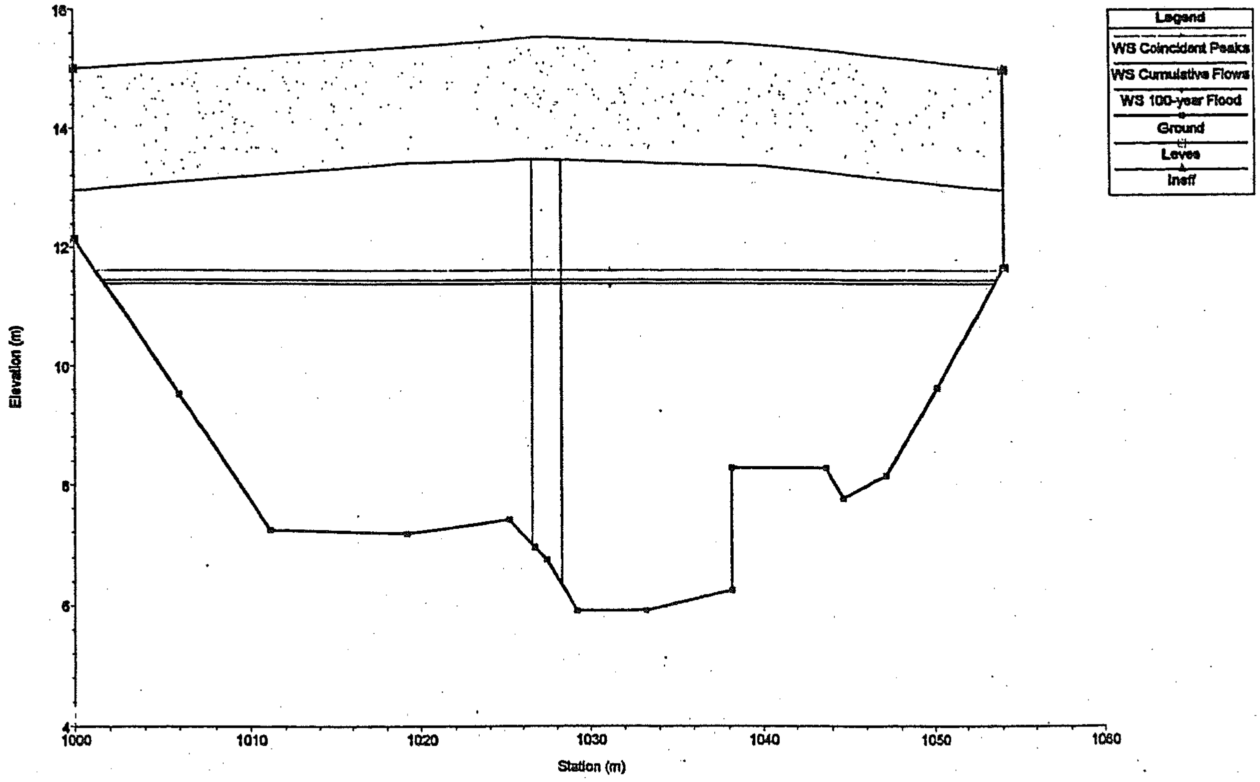


Figure 12. Water Surface Elevations at Highway 101 Bridge

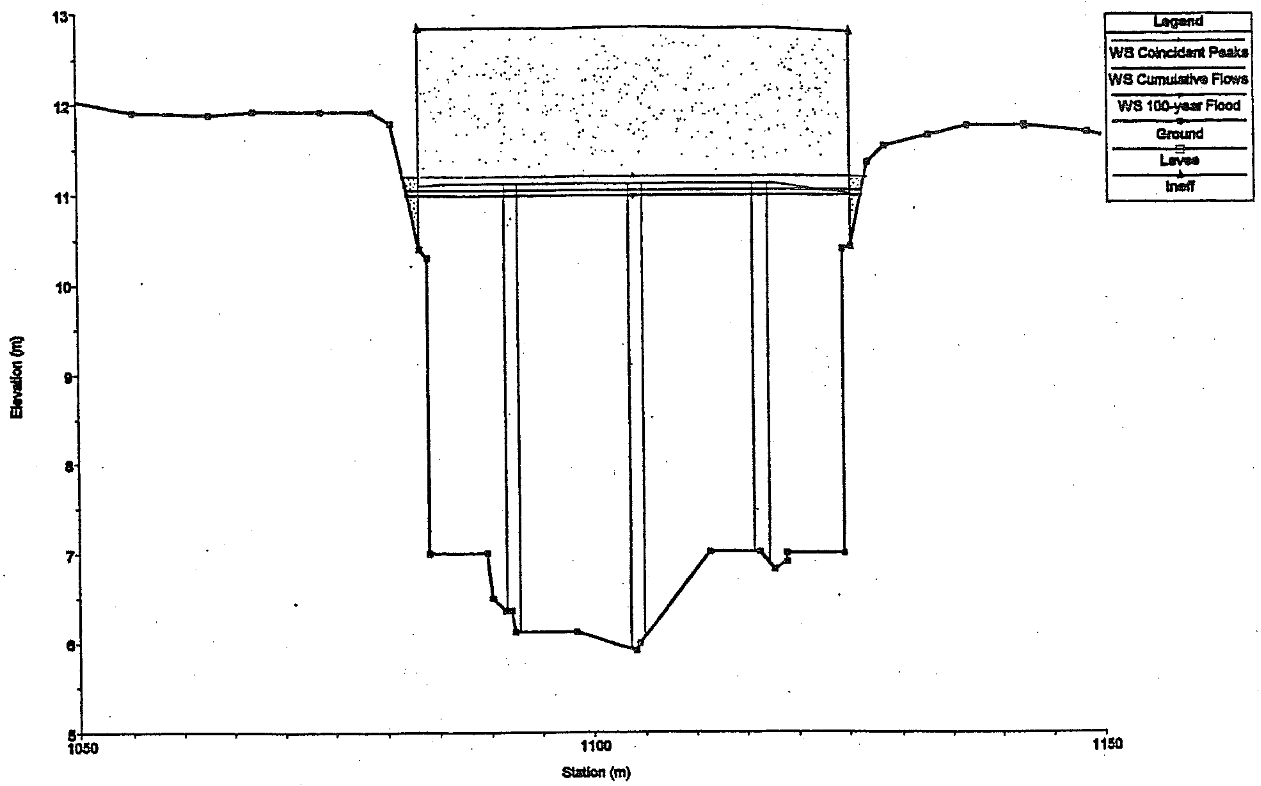


Figure 13. Water Surface Elevations at Trimble Road Bridge

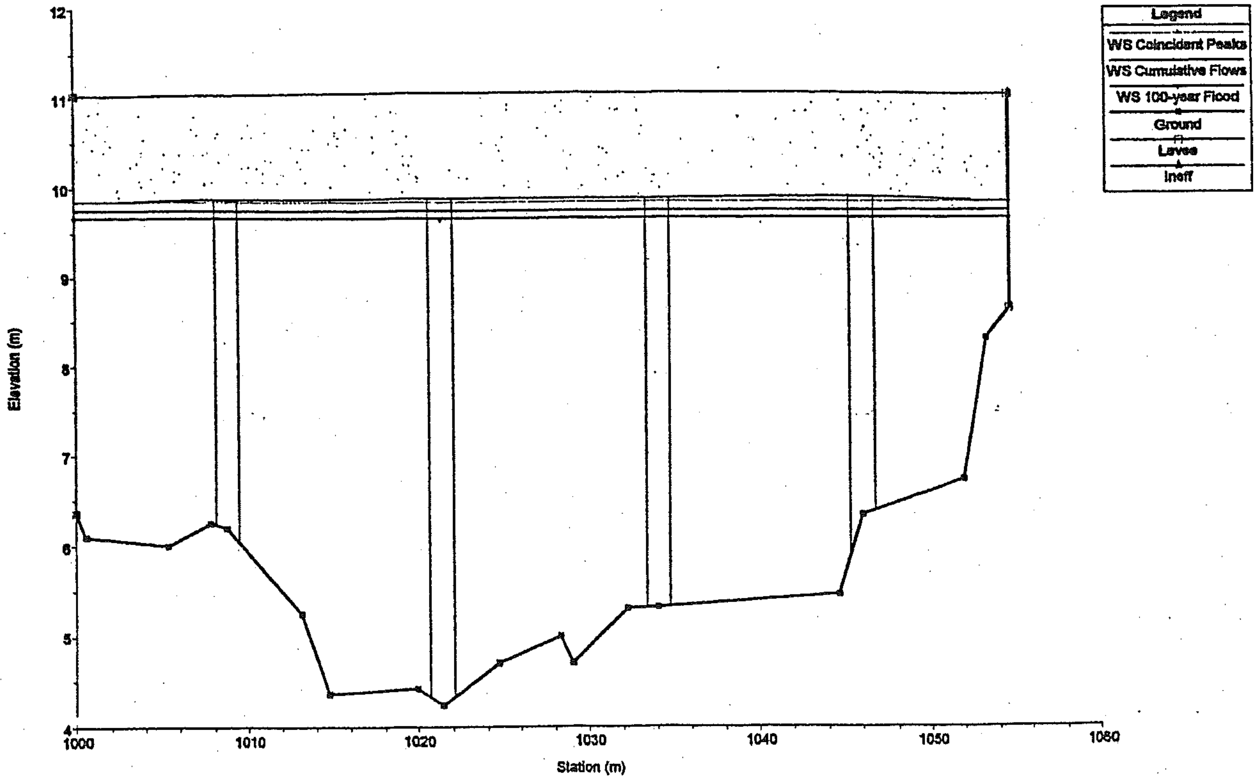


Figure 14. Water Surface Elevations at Montague Expressway Bridge

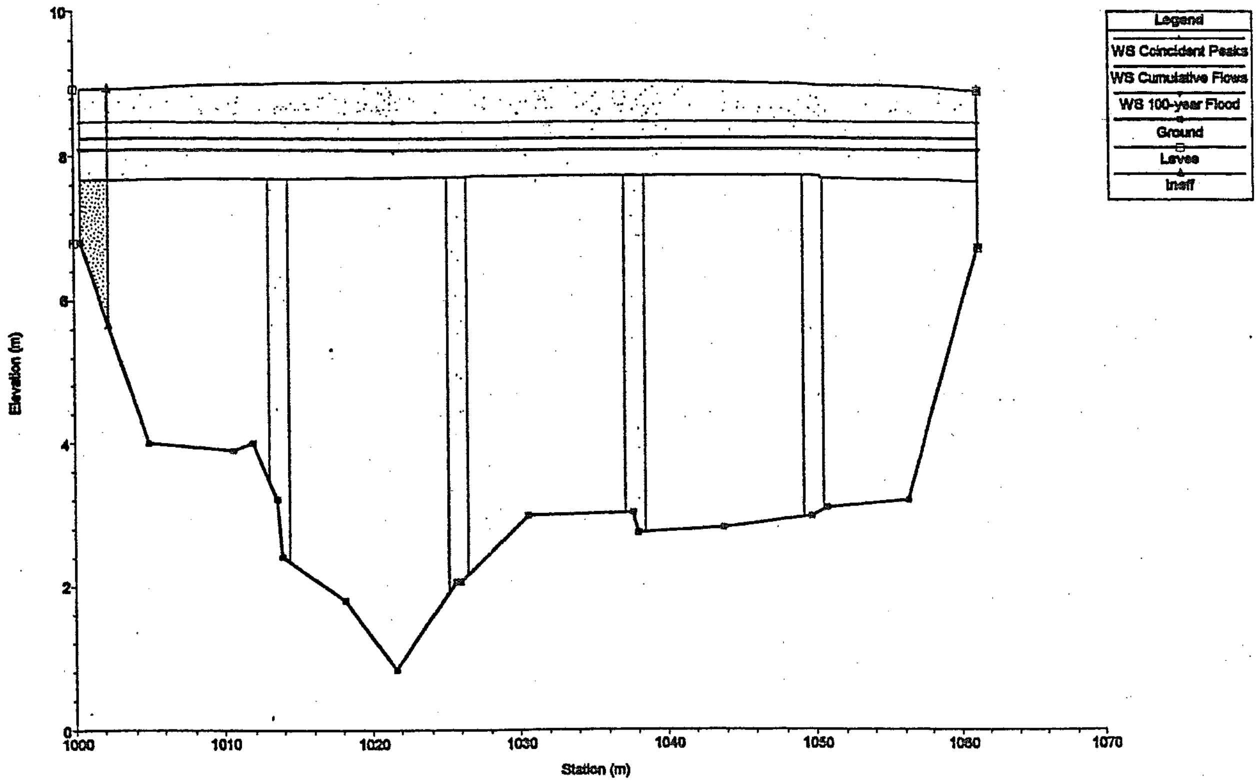


Figure 15. Water Surface Elevations at Tasman Drive Bridge

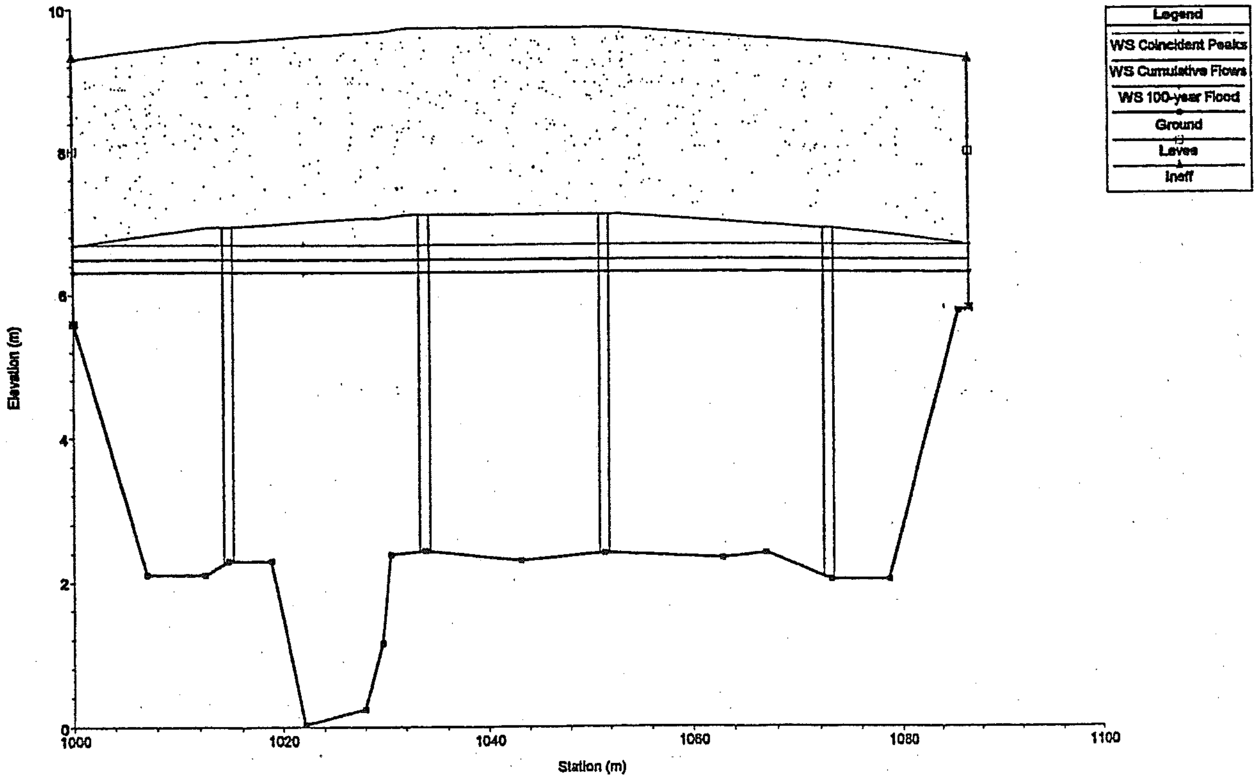


Figure 16. Water Surface Elevations at East Bound 237 Bridge

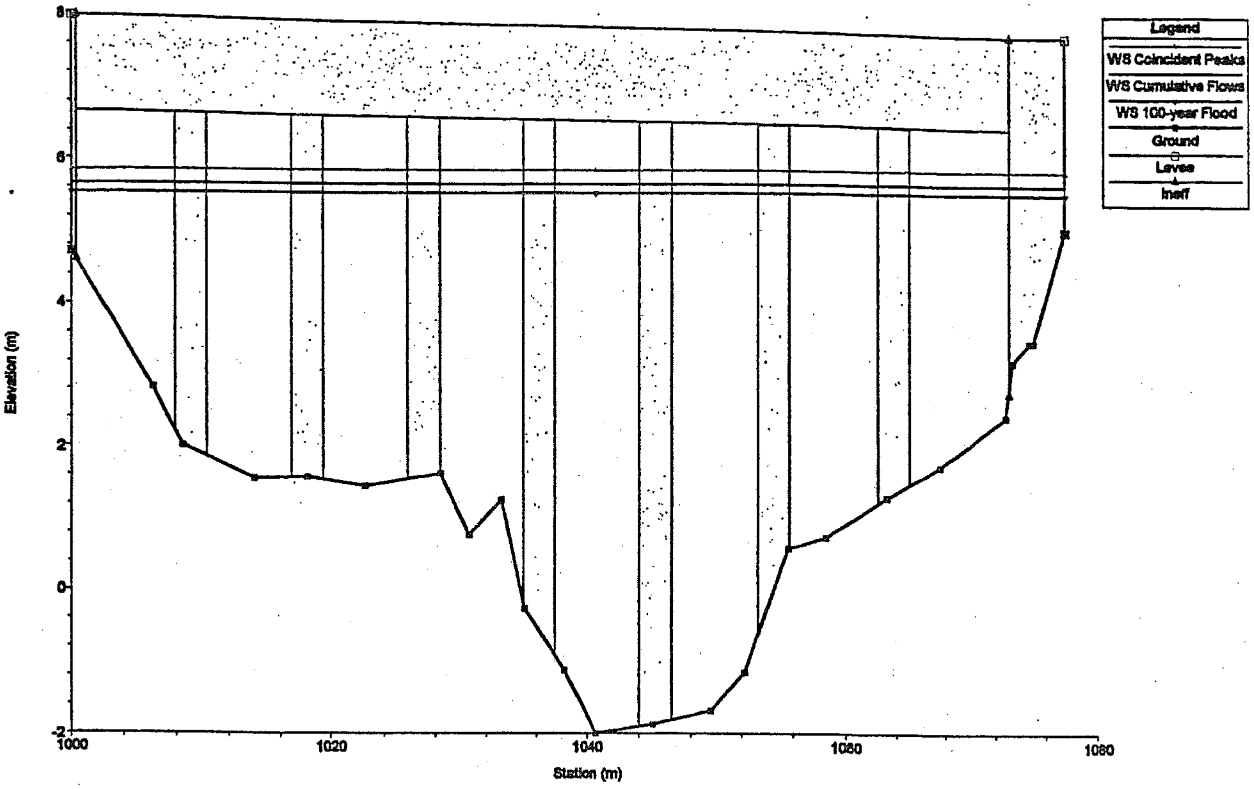


Figure 17. Water Surface Elevations at West Bound 237 Bridge

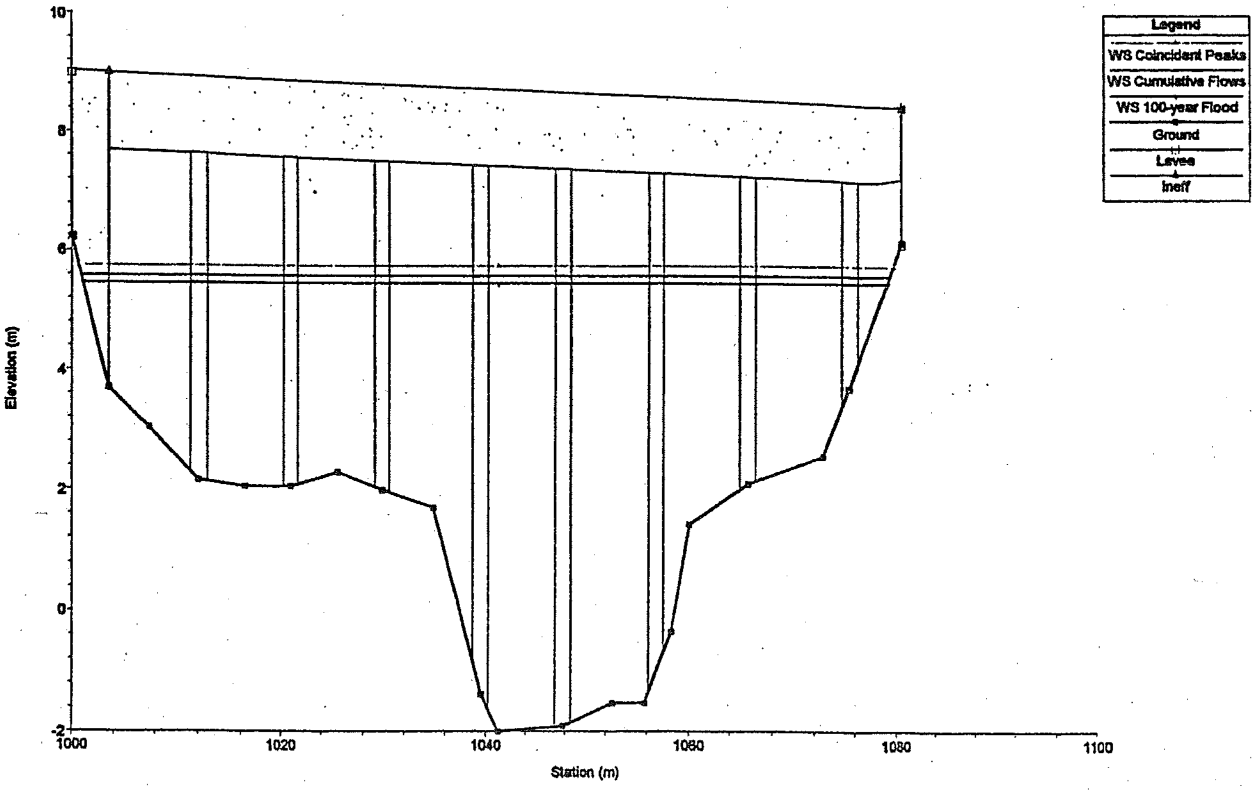


Figure 18. Water Surface Elevations at Gold Street Bridge

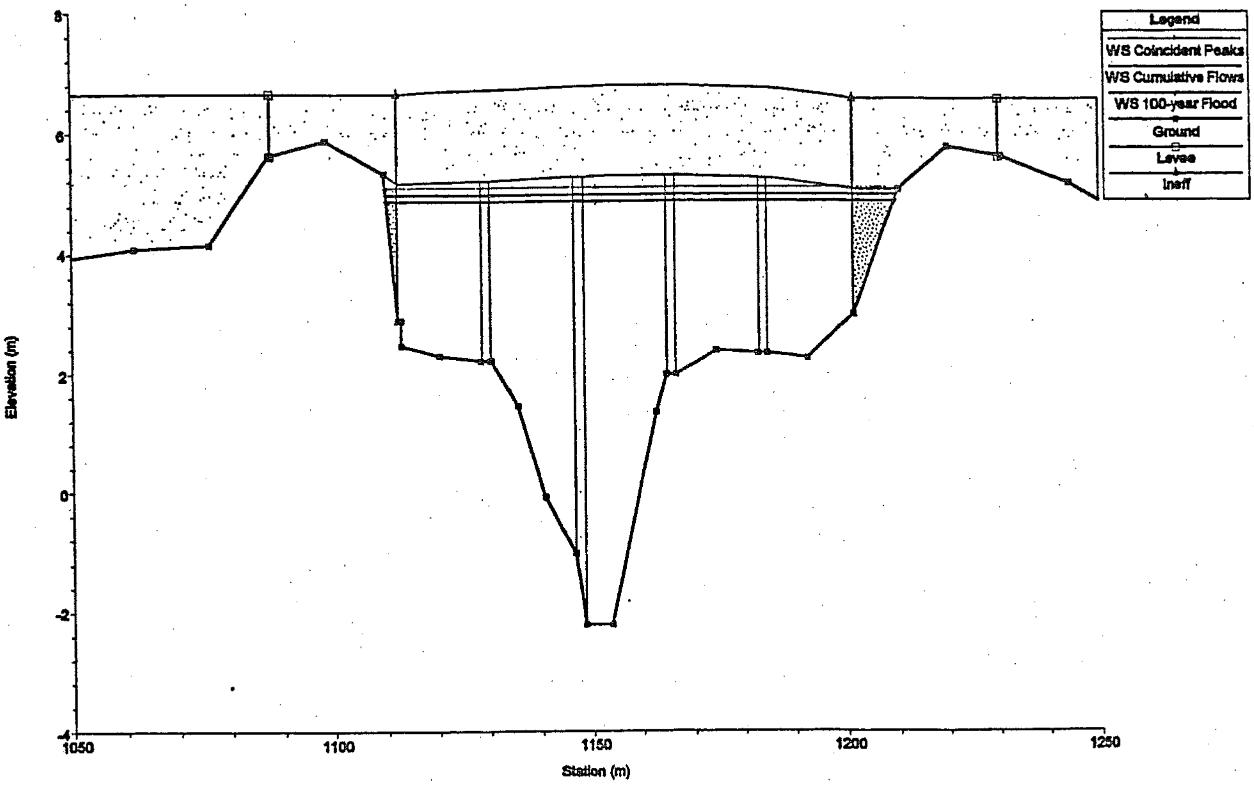
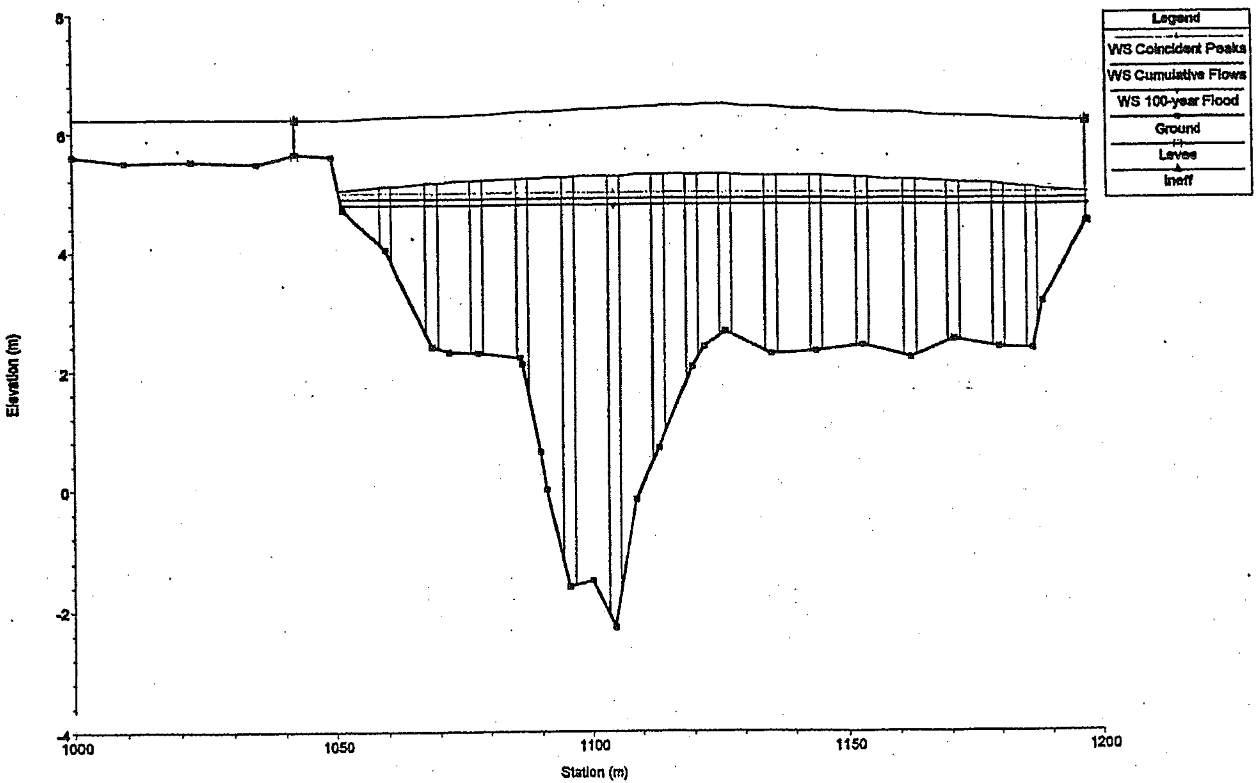


Figure 19. Water Surface Elevations at UPRR Bridge



Effects to Baylands from Adding Interior Drainage Flows to USACE's Design Hydrograph

Purpose

The purpose of the Baylands planning study is to assess and compare existing against proposed LGR Project conditions, including

- design event water surface profiles along Alviso and Guadalupe Sloughs
- the volume and depths of excess water that drains into the salt ponds west of Alviso Slough during the design event
- develop conceptual Baylands components (mitigation improvements) to mitigate for potential LGR-project-induced hydraulic impacts to the Baylands

Previous analyses of the LGR Project and the Baylands did not include interior drainage (between I-880 downstream to UPRR) as part of the design event hydrograph. Therefore, the purpose of the specific analyses reported herein is to identify "interior drainage-induced" hydraulic impacts to the Baylands (e.g., changes to water surface elevation along Alviso Slough and depths of ponding in the salt ponds).

Methods

Preceding discussions describe the methods used to estimate flow contributions from the most significant pumped or gravity drain inflows found downstream of I-880. Modeling methods used to assess the hydrodynamics of the Baylands are reported in previous documents provided by CH2M HILL and the District.

Summary of Findings

Five different hydrologic scenarios are analyzed to identify possible hydraulic impacts to the Baylands resulting from project improvements to the LGR upstream of the UPRR Bridge:

Scenario 1. Present-Day, Pre-project, No LGR Interior Drainage (PDPPNoID). This scenario represents the present-day (existing) conditions excluding any LGR interior drainage inflows between I-880 and the UPRR Bridge. And, the LGR can only deliver a peak flow of 14,000 cfs to Alviso Slough under this scenario.

Scenario 2. Present-Day, Pre-project (PDPP). This present-day, pre-project scenario assumes that the present LGR channel capacity upstream of UPRR can only deliver a 14,000-cfs peak discharge hydrograph to Alviso Slough. Interior drainage is included up to that point at which the LGR discharges reach 14,000 cfs, whereby any flow above the 14,000 cfs, whether riverine or interior drainage leaves the system and does not reach the UPRR bridge and does not enter Alviso Slough.

Scenario 3. USACE Design Hydrograph with No Interior Drainage and No Engineered Weir (USACE-NoIDNoW). This scenario uses the USACE design hydrograph with no interior drainage added to the design hydrograph downstream of I-880. This hydrograph is the four-day "LCA" 17,000-cfs peak-discharge hydrograph delivered to the LGR at I-880 from the flood control project being implemented between I-880 and I-280 through Downtown San Jose, California. This scenario also excludes construction of a 1,000 linear foot engineered weir between Alviso Slough and Cargill Pond A8. This scenario also assumes that the east Alviso Slough levee from UPRR to the County Marina including the Marina perimeter have been improved to eliminate the flood threat to Alviso from high flows in Alviso Slough.

Scenario 4. USACE Design Hydrograph with No Interior Drainage (USACE-NoID). This scenario uses the USACE design hydrograph excluding interior drainage entering the LGR downstream of I-880 (USACE-NoID). This scenario delivers the same 17,000-cfs-peak-discharge hydrograph to Alviso Slough as Scenario 3, however, Scenario 4 includes a 1,000-lf engineered weir between Alviso Slough and Cargill Pond A8 to reduce hydraulic impacts (flow, stage and velocities) to Alviso Slough downstream of the County Marina to essentially pre-project conditions.

Scenario 5. USACE Design Hydrograph with Interior Drainage (USACE-WithID). This scenario combines the USACE-design hydrograph with inflows from fourteen interior drainage locations discussed above. The USACE-WithID scenario increases the LGR peak flow to approximately 18,350-cfs and delivers a greater event volume to the Baylands compared to the USACE-NoID conditions (Scenarios 3 & 4).

Figure 20 shows the LGR inflow hydrographs used in modeling the above five (5) scenarios. (Note that Scenarios 3 and 4 use the same LGR inflow hydrograph.)

Key Results: Following is a summary of key results from this study of the effects of five hydrologic scenarios in the Baylands:

- Table 5 summarizes the inundation depths to Cargill ponds and the USFWS Refuge (pond A6) for the five (5) different scenarios described above. Depths for the Cargill ponds are rounded to the nearest half-foot, and to the nearest quarter-foot for the Refuge (pond A6). Also listed in Table 5 are the peak discharges assumed for each scenario, the estimated event volumes based on 4-day event duration and a summary of other hydrologic boundary conditions used for each scenario.
- Table 6 shows the actual computed inundation depths in each pond to the nearest 1/100 of a foot as shown in Table 5. NHC believes that the computed results are accurate only to the nearest ½ foot as stated in Table 5.
- Figure 21 shows the actual computed inundation depths for Ponds A5-A8 and the Refuge.
- Table 7 shows the maximum computed water surface elevations in the various ponds for each of the five scenarios, as well as the pre-storm starting elevation for each pond.
- Table 8 shows the estimated stormwater volumes that "spill" into each of the ponds and the Refuge for each of the five hydrologic scenarios. Values shown in Table 8 are "net" volumes after the 4-day storm simulation period, only. Some storage locations receive more volume above these values during the event, but have "leaked" a portion of that volume either into adjacent storage areas (ponds) or out into one of the sloughs.

- Table 9 and Figure 22 summarize the approximate 4-day volumes and peak discharge rates across the Alviso Slough-to-Pond A8 overflow (weir) for the five scenarios.
- Table 5 shows that adding interior drainage volume to the existing conditions hydrograph results in an increased inundation of Cargill Ponds A5-A8 by about a half-foot of water (comparing Scenarios 1 & 2). Adding interior drainage volume to the USACE LCA hydrograph (comparing Scenarios 4 & 5) results in about a half-foot increase in inundation to Cargill Ponds A7 and A8(dry), as well as an increase of about 1.25 feet to the USFWS Refuge. Although Table 5 indicates that the USFWS Refuge is not impacted under Scenario 3, it is important to acknowledge that modeling results showed that inundation of Ponds A5 and A7 was at the very top of the Refuge levee with no freeboard to spare.
- Depths of inundation in Ponds A5, A7, and A8 increased by about one foot between existing conditions and USACE LCA Project conditions (comparing Scenarios 1 and 3).
- Inclusion of interior drainage into the LGR Project (Scenario 5) results in inundation of the Refuge to a depth of approximately 3.25 feet. The refuge does not flood in either Scenarios 1, 2 or 3.
- Approximately 4,500 AF of runoff volume is added to the USACE LCA design hydrograph if interior drainage effects are added downstream of I-880. Approximately 2,100 acre-feet (roughly 47 percent) of this added volume spills over the engineered weir into Cargill Ponds A5, A7, and A8 and the Refuge. The result is increased ponding depths in A5, A7, and A8 and an additional 1.25 feet of ponding in the Refuge to a total depth of approximately 3.25 feet. (Refer to Table 5 and Table 9, Scenarios 4 and 5.)
- The estimated total flood storage capacity of the Cargill Ponds A5, A7, and A8 (with no freeboard and without impacting the Refuge) above their present dry-ground or existing salt-pond elevations is approximately 11,600 acre-feet (AF). Under present-day conditions excluding LGR interior drainage (Scenario 1), approximately 8,300 AF spill into Ponds A5, A7, and A8 (Table 9 and Figure 22). Under Scenario 2, approximately 9,100 AF spill into Ponds A5, A7, and A8 without impacting the Refuge (Pond A6). In Scenario 3, approximately 9,800 AF spill into Ponds A5, A7, and A8. Under Scenario 4 which introduces the engineered weir mitigation measure between Alviso Slough and Pond A8, approximately 12,200 AF spill into A5-A8. Because this volume is greater than the flood capacity of Ponds A5, A7 and A8, the results indicate some flooding into the Refuge to a depth of approximately 2.0 feet. Scenario 5 results in approximately 14,300 AF spilling into the ponds resulting in about 3.25 feet inundating the Refuge. Under Scenario 5 excess flood waters entering A5-A8 spill into the Refuge with some flow draining back over the levees into Alviso and Guadalupe Sloughs near the peak of the design event. (Refer to Table 9 and Figure 22.)
- Present conditions exclude the "engineered weir" on the west levee adjacent to Pond A8. In the past, only a low section of levee functioned as a default weir allowing a portion of the high-river flows passing Alviso to spill to the west over the low section in the levee. One of the proposed project mitigation components is an engineered weir to replace the default low section. Preliminary analyses show that a 1,000-foot-long, multi-crested weir is required to maintain pre-LGR Project water surface profiles along Alviso Slough downstream of the County Marina. Construction of such a weir may also lower the project design water-

surface profile near Gold Street Bridge and UPRR Bridge by as much as 0.5 feet. Further detailed design studies are required to verify the actual dimensions, orientation and performance of this concept plan.

- Figure 23 compares computed water surface profiles in Alviso Slough for (1) present-day pre-project conditions, (2) USACE design conditions excluding interior drainage and without an engineered weir, (3) the LGR Project with interior drainage but without an engineered weir, and (4) the LGR Project including interior drainage with the engineered weir included (Scenarios 2, 3, & 5). No freeboard allowance currently exists along Alviso Slough for present-day conditions and will not be provided following with-project improvements. The marked areas adjacent to the weir in Figure 23 indicate locations where NHC made "glass wall assumptions" to simulate the "filling in" of low sections along the west levee to avoid floodwater from flanking the 1,000-foot weir. The need and methods to fill these areas will be determined during detailed design. The height of the assumed in-fill of these areas was set at one foot above the (LGR Project with weir in-place) water surface elevation. If the adjacent levee crowns are not raised to isolate the weir, the tops of those exposed levee crowns and the back sides of the levee will need armoring to accommodate overtopping without erosion. Due to the low probability of the magnitude of a design event, armoring in-place without much filling may be the most reasonable and economical option for these low spots. Further consideration of this option will be made during final design.
- As a means to evaluate options for mitigating the inundation impacts to Ponds A5 through A8 and the Refuge, computations were made to evaluate pumping as a means to restore ponds to their pre-storm water surface elevations, or complete evacuation in the case of the Refuge or Pond A8(dry). A 50-cfs capacity pump size was assumed. Ponds A5, A7, A8(dry) and A8(wet) were assumed to have one pump each, and the Refuge was given two (2) pumps to accelerate the pump-out, for a total of 6 pumps running simultaneously. It was assumed that pumping would commence 14 days after the end of the 4-day design storm event, and pumps would then run continuously until pre-storm conditions are re-established.
- Figure 24 shows the results of the pumping analysis. With six 50-cfs capacity pumps, the evacuation durations for ponds A5, A7 and A8 (dry and wet) are 44 to 54 days, and about 24 days for the Refuge.

Baylands Hydraulic Analysis

A UNET model developed by NHC is used as a planning tool to evaluate the unsteady hydraulic characteristics of the 25-square-mile Baylands study area. This UNET model allows for analysis of the effects of unsteady flow conditions associated with various phased inflow hydrographs, downstream tidal boundary conditions, and the exchange of excess floodwaters into or out of storage areas (predominantly Cargill salt evaporation ponds). Following is a summary of the hydraulic boundary conditions used for the Baylands analyses and a brief listing of key exclusions or limitations of these analyses.

Boundary Conditions. The following list summarizes the common assumptions and boundary conditions used for all scenarios as well as present-day (existing) conditions analysis, LGR

Project conditions analysis excluding the interior drainage flows downstream of I-880, and LGR Project conditions analysis including interior drainage flows downstream of I-880.

Common Assumptions and Boundary Conditions Used for All Scenarios

A. A four-day-duration flood event is used to analyze the Baylands hydraulics. This allows for simulation of the USACE's two-day Guadalupe River hydrograph (extended to 4 days for these analyses) as well as the USACE's four-day Coyote Creek hydrograph including a lag in the Coyote Creek hydrograph.

B. Hydrographs for the Coyote Creek and Guadalupe Slough tributaries (San Tomas, Calabazas, Sunnyvale East, and Sunnyvale West) are shown in Figure 25 and Figure 26.

C. The Coyote Creek 1-percent event hydrograph is based on the USACE's Coyote Creek Project design hydrograph and is lagged by eleven (11) hours with respect to the peak of the LGR hydrograph.

D. The tide boundary condition at Dumbarton Bridge (the downstream boundary of the Baylands UNET model) is a 10-year tide (see Figure 27). The 10-year-tide shape is based on the historical tide that occurred during the March 1995 flood event. The 10-year-tide peak, prescribed by the USACE, is produced by amplifying all hourly tide ordinates above the mean tide level by the ratio of the peak 10-year USACE tide estimate and the peak tide produced during the March 1995 storm tide. Tide ordinates below mean tide level were not modified. The 10-year tide series was then translated to synchronize the peak tide stage to within an hour of the LGR peak flow rate entering Alviso Slough. The result is a design tide that includes conditions associated with high river discharge conditions entering the bay, low pressure in the South Bay, and storm surge or setup in the South Bay expected during a major regional storm event.

E. When the design event occurs, simulations assume that all storage volumes in each of the ponds are available and that no storm nesting or antecedent ponding effects existing in the ponds west of Alviso Slough.

F. If river or ponding stages exceed the top of levee elevations in the model, we assume a "glass wall" condition exists and do not account for spills over the levees if they are slightly lower than computed water surface elevations. We do account for spills and levee overtopping (modeled as weir flow) at a few key locations where survey data indicates low spots in the levees.

Present-day (Existing) Conditions Analysis

G. The maximum LGR event discharge entering Alviso Slough is 14,000 cfs, limited by upstream bankfull channel capacity (see Figure 20, Scenario 2).

H. We assume that no engineered improvements have been made in the Baylands study area for the present-day, existing conditions. Floodwaters spilling into the Cargill ponds west of Alviso Slough occur over the existing low section of the west levee across from the Alviso Yacht Club. We assume the accuracy of the computed ponding depths to be within one half foot, however, the level of detail used in the UNET model to depict "Baylands flooding processes under existing conditions" is only as good as the accuracy of the available topographic and bathymetric data.

I. The interior levee that separates the USFWS refuge from Cargill Ponds A5 and A7 was surveyed recently. Results of those surveys indicate that flood waters in Ponds A5 and A7 start to spill into the Refuge at approximately elevation 10.0 feet. We assumed that no improvements would be made to the top-of-levee profile separating ponds A5 and A7 from the Refuge.

LGR Project Conditions Analysis Excluding Interior Drainage Downstream of I-880

J. The LGR design hydrograph contains a peak discharge of 17,000 cfs entering Alviso Slough (see Figure 20, Scenarios 3 & 4).

K. A 1, 000-foot-long engineered weir on the west levee across from Alviso allows controlled overflow from Alviso Slough into Cargill Pond A8. This concept design will be refined during final design of the weir.

L. Improvements to the County Marina parking lot and levees prevent high stages in Alviso Slough from spilling through the marina into Alviso.

M. The interior levee between A8D (dry portion of A8) and A8W (active salt pond evaporator) has been surveyed recently and field data indicates that flows spill across the levee at about elevation 3.0 feet.

N. The interior levee between A8 and A5–A7 has been recently surveyed and the results indicate that flows spill from A8 into A5/A7 at about elevation 3.5 feet.

Boundary conditions **A, B, C, D, E, F,** and **I** above are included in this analysis which does not include the effects of interior drainage.

LGR Project Conditions Analysis Including Interior Drainage Flows Downstream of I-880

O. The with-interior drainage design hydrograph includes a peak discharge of approximately 18,350 cfs entering Alviso Slough (see Figure 20). Boundary conditions **A, B, C, D, E, F, I, K, L, M, N and O** (summarized above) are included in this analysis.

Key Assumptions and Limitations of Baylands Hydraulic Analysis

The results contained herein are for planning purposes and are not suitable for final design or construction. The following is a summary of key assumptions and limitations of the present Baylands analyses:

- All modeling scenarios assume that all slough and interior pond levees remain intact during the entire storm duration and afterwards, even if the levees are overtopped. We assume that prior to construction of any Baylands components that a design-level hydraulic analyses will be performed and the structural integrity of the non-engineered levees will be determined for with-project conditions.

- Levee overtopping or "Leaks" above 10+ foot elevation on the Alviso Slough and A8W levee are possible, but are not presently included in the model. Only the lowest known locations based on existing available surveys are coded as overtopping weir locations in the UNET model.

- Guadalupe Slough contributes some flooding to Ponds A5, A8D, and maybe A7. More up-to-date, top-of-levee profile data is required to more accurately compute the potential contributions from the Guadalupe Slough.

- The occurrence of future subsidence or levee settlement is not included in the analysis.
- Long-term sea level is assumed constant and the possible changes in project performance during future sea level rise in the South Bay is not considered.
- All of the dimensions, sizes, heights, etc. used to depict physical conditions in the models are from existing, readily available data. Some of these data are sparsely spaced and quite old.
- No analyses have been performed to evaluate the system's performance for events greater than the design event described herein.
- The effects of wind setup and waves are not included in any of the analyses. The effects of wind setup and waves during significant storm events should be evaluated during final design.
- The estimated dimensions of the engineered overflow weir are based on tranquil conditions in the interior Ponds (A5–A8). The effects on the weir's performance during rare storm events due to wind-setup and wave-induced tailwater conditions have not been assessed.
- Pump-out durations assume that all six pumps are accessible and function continuously for the full period of pumping following the design event. The durations are also based on continuous (24 hours per day) pumping until full restoration is achieved.

Figure 20. Baylands Analyses LGR Inflow Hydrographs

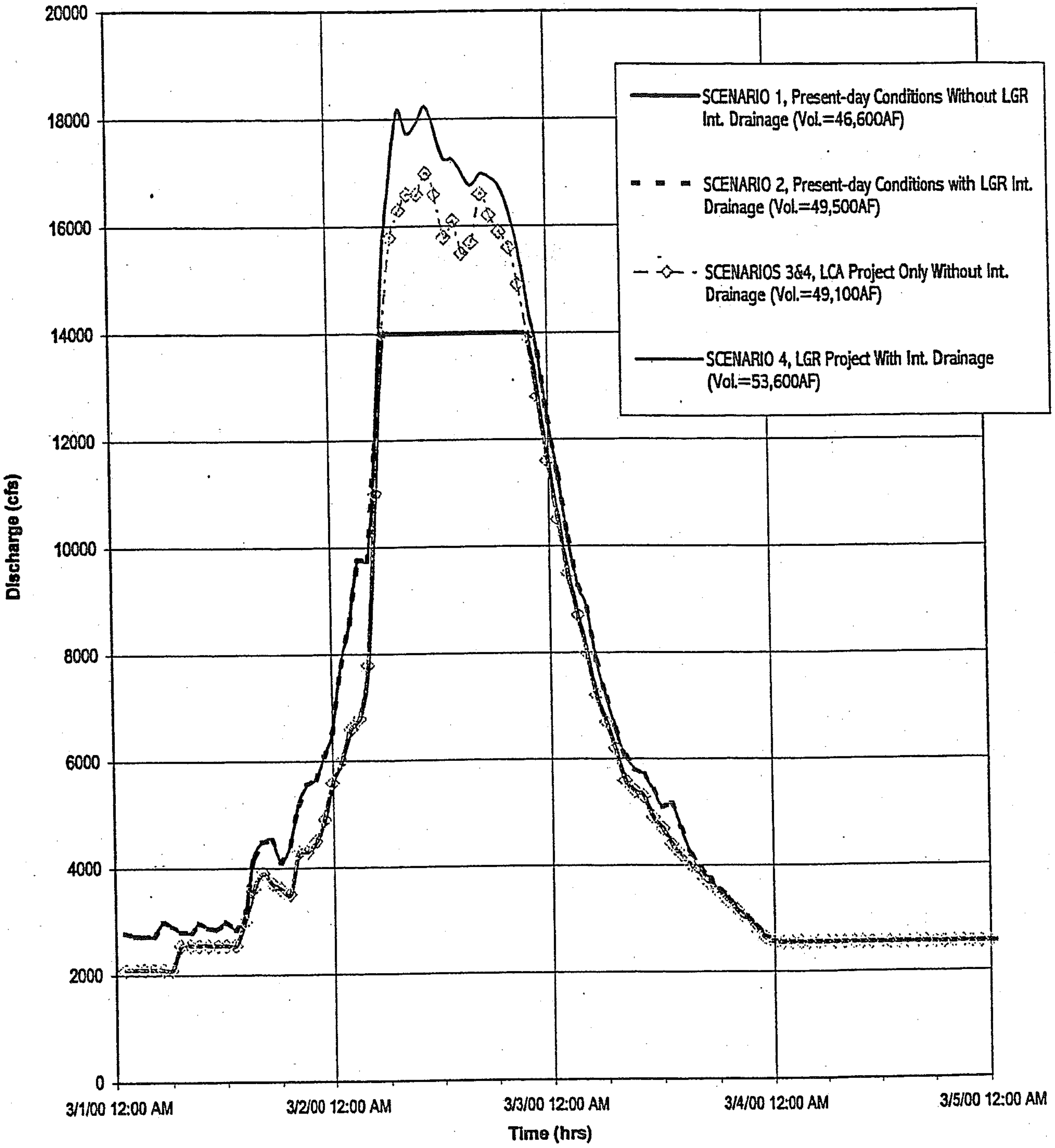


Table 5. Lower Guadalupe River Flood Protection Project
Supplemental Baylands Hydraulic Analysis
Estimated Inundation Depths (5/17/02)

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	Existing (Baseline) Conditions Without LGR Pumping	Existing (Baseline) Conditions With LGR Pumping	LCA Hydrograph Without Pumping and No Improved Weir at A8W	LCA Hydrograph Without Pumping and With Improved Weir at A8W	LGR Project With Pumping and With Improved Weir at A8W
LGR Peak Discharge:	14,000 cfs	14,000 cfs	17,000 cfs	17,000 cfs	18,350 cfs
LGR Event Volume*:	46,600 AF	49,500 AF	49,100 AF	49,100 AF	53,600 AF
Other Tributaries:	1% Events	1% Events	1% Events	1% Events	1% Events
Tide at Dumbarton Bridge:	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr
	Depth(1) (in Feet) of Inundation for Each Scenario				
Cargill Pond A5	6.0	6.5	7.0	8.0	8.0
USFWS Refuge (A6)(2)	-	-	(3)	*2.00*	*3.25*
Cargill Pond A7	6.0	6.5	7.0	8.0	8.5
Cargill Pond A8(Dry)	6.0	6.5	7.0	8.0	8.5
Cargill Pond A8(Wet)	8.5	9.0	9.5	10.5	10.5
Cargill Pond A9	-	-	-	-	-
Cargill Pond A10	-	-	-	-	-
Cargill Pond A11	-	-	-	-	-
Cargill Pond A12	-	-	-	-	-
Cargill Pond A13	0.5	0.5	0.5	0.5	0.5
Cargill Pond A14	-	-	-	-	-
Cargill Pond A15	0.5	0.5	0.5	0.5	0.5
Cargill Pond A16	-	-	-	-	-
Cargill Pond A17	4.5	4.5	4.5	4.5	4.5
Cargill Pond A3(East)	Nominal(4)	Nominal(4)	Nominal(4)	Nominal(4)	Nominal(4)
Cargill Pond A3(West)	-	-	-	-	-
		R11	R11G	R11H	R11F

* Volume based on 4-day event simulation.

(1) Rounded to the nearest half-foot; effects of wind not accounted for in values.

(2) Rounded to the nearest quarter-foot; effects of wind not accounted for in values.

(3) The water surface in A5 and A7 are right at the very top of the levee, just starting to spill into the Refuge.

(4) Nominal means any computed depth of flooding less than 0.25 feet.

Table 6. Lower Guadalupe River Flood Protection Project
Supplemental Baylands Hydraulic Analysis
Computed Inundation Depths (5/17/02)

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	Existing (Baseline) Conditions Without LGR Pumping	Existing (Baseline) Conditions With LGR Pumping	LGR Project Without Pumping and No Improved Weir at A8W	LGR Project Without Pumping and With Improved Weir at A8W	LGR Project With Pumping and With Improved Weir at A8W
LGR Peak Discharge:	14,000 cfs	14,000 cfs	17,000 cfs	17,000 cfs	18,350 cfs
LGR Event Volume*:	46,600 AF	49,500 AF	49,100 AF	49,100 AF	53,600 AF
Other Tributaries:	1% Events	1% Events	1% Events	1% Events	1% Events
Tide at Dumbarton Bridge:	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr
Depth (in feet) of Inundation for Each Scenario					
Cargill Pond A5	5.95	6.50	7.21	7.87	8.24
USFWS Refuge (A6)				2.05	3.24
Cargill Pond A7	5.99	6.54	7.25	7.94	8.34
Cargill Pond A8(Dry)	5.90	6.45	7.17	7.89	8.32
Cargill Pond A8(Wet)	8.27	8.82	9.54	10.26	10.69
Cargill Pond A9					
Cargill Pond A10					
Cargill Pond A11					
Cargill Pond A12					
Cargill Pond A13	0.26	0.26	0.26	0.26	0.26
Cargill Pond A14					
Cargill Pond A15	0.51	0.51	0.51	0.51	0.51
Cargill Pond A16					
Cargill Pond A17	4.56	4.56	4.56	4.56	4.56
Cargill Pond A3(East)	0.07	0.07	0.11	0.10	0.07
Cargill Pond A3(West)	0.01	0.01	0.01	0.01	0.01

* Volume based on 4-day event simulation.

Figure 21. Computed Inundation Depths
Lower Guadalupe River Flood Protection Project
Supplemental Baylands Hydraulic Analysis

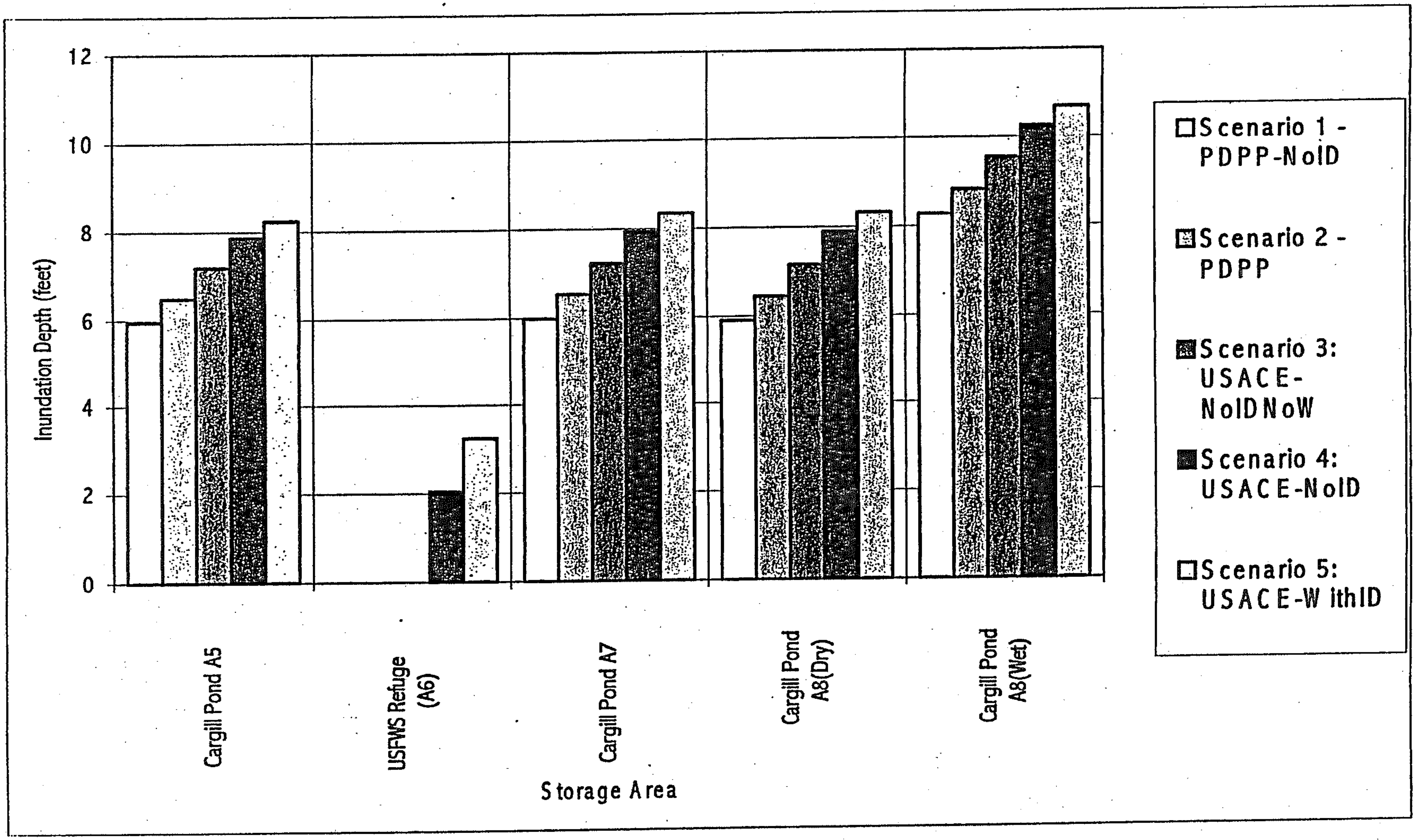


Table 7. Lower Guadalupe River Flood Protection Project

Supplemental Baylands Hydraulic Analysis

Maximum Computed Water Surface Elevations (5/17/02)

		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	Pre-Storm Starting Elevations (feet)	Existing (Baseline) Conditions Without LGR Pumping	Existing (Baseline) Conditions With LGR Pumping	LCA Hydrograph Without Pumping and No Improved Weir at A8W	LCA Hydrograph Without Pumping and With Improved Weir at A8W	LGR Project With Pumping and With Improved Weir at A8W
LGR Peak Discharge:	-	14,000 cfs	14,000 cfs	17,000 cfs	17,000 cfs	18,350 cfs
LGR Event Volume*:	-	46,600 AF	49,500 AF	49,100 AF	49,100 AF	53,600 AF
Other Tributaries:	-	1% Events	1% Events	1% Events	1% Events	1% Events
Tide at Dumbarton Bridge:	-	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr
	Water Surface Elevation (feet) of Inundation by Scenario					
Cargill Pond A5	2.85	8.80	9.35	10.06	10.72	11.09
USFWS Refuge (A6)	3.00	NC	NC	NC	5.05	6.24
Cargill Pond A7	2.81	8.80	9.35	10.06	10.75	11.15
Cargill Pond A8(Dry)	2.90	8.80	9.35	10.07	10.79	11.22
Cargill Pond A8(Wet)	0.53	8.80	9.35	10.07	10.79	11.22
Cargill Pond A9	-0.32	NC	NC	NC	NC	NC
Cargill Pond A10	-0.84	NC	NC	NC	NC	NC
Cargill Pond A11	4.20	NC	NC	NC	NC	NC
Cargill Pond A12	3.62	NC	NC	3.67	NC	NC
Cargill Pond A13	3.26	3.52	3.52	3.52	3.52	3.52
Cargill Pond A14	-0.06	NC	NC	NC	NC	NC
Cargill Pond A15	5.88	6.39	6.39	6.39	6.39	6.39
Cargill Pond A16	8.20	NC	NC	NC	NC	NC
Cargill Pond A17	8.20	12.76	12.76	12.76	12.76	12.76
Cargill Pond A3(East)	0.85	0.92	0.92	0.96	0.95	0.92
Cargill Pond A3(West)	0.85	0.86	0.86	0.86	0.86	0.86

* Volume based on 4-day event simulation.

NC = No change in elevation from event.

Table 8. Lower Guadalupe River Flood Protection Project
Supplemental Baylands Hydraulic Analysis
Approximate Net Volumes Per Location by Scenario (5/17/02)

		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	Approx. Area of Storage Pond (Acres)	Existing (Baseline) Conditions Without LGR Pumping	Existing (Baseline) Conditions With LGR Pumping	LCA Hydrograph Without Pumping and No Improved Weir at A8W	LCA Hydrograph Without Pumping and With Improved Weir at A8W	LGR Project With Pumping and With Improved Weir at A8W
LGR Peak Discharge:	-	14,000 cfs	14,000 cfs	17,000 cfs	17,000 cfs	18,350 cfs
LGR Event Volume*:	-	46,600 AF	49,500 AF	49,100 AF	49,100 AF	53,600 AF
Other Tributaries:	-	1% Events	1% Events	1% Events	1% Events	1% Events
Tide at Dumbarton Bridge:	-	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr
	Approx. Stormwater Volumes$^{(1)}$ (Acre-Feet) for Each Location by Scenario					
Cargill Pond A5	626.8	3,729	4,074	4,519	4,933	5,165
USFWS Refuge (A6)	342.6	None	None	None	702	1,110
Cargill Pond A7	259.8	1,556	1,699	1,884	2,063	2,167
Cargill Pond A8(Dry)	181.2	1,069	1,169	1,299	1,430	1,508
Cargill Pond A8(Wet)	414.8	3,430	3,658	3,957	4,256	4,434
Cargill Pond A9	360.0	None	None	None	None	None
Cargill Pond A10	260.0	None	None	None	None	None
Cargill Pond A11	264.3	None	None	None	None	None
Cargill Pond A12	311.1	None	None	16	None	None
Cargill Pond A13	270.2	70	70	70	70	70
Cargill Pond A14	344.0	None	None	None	None	None
Cargill Pond A15	253.4	129	129	129	129	129
Cargill Pond A16	242.5	None	None	None	None	None
Cargill Pond A17	133.2	607	607	607	607	607
Cargill Pond A3(East)	448.1	31	31	49	45	31
Cargill Pond A3(West)	536.3	5	5	5	5	5

* Volume based on 4-day event simulation.

(1) These are net volumes after the 4-day simulation period. Some storage locations actually receive more volume than these values, but have "leaked" a portion of the water they've received either into another storage area (or areas), or out into one of the sloughs.

Table 9. Lower Guadalupe River Flood Protection Project
Supplemental Baylands Hydraulic Analysis
Alviso Slough-to-Cargill Pond A8 Peak Discharges and Volumes (5/17/02)

17K 18,350

Overflow from Alviso Slough into Cargill Pond A8	Existing (Baseline) Conditions Without LGR Pumping	Existing (Baseline) Conditions With LGR Pumping	LCA Hydrograph Without Pumping and No Improved Weir at A8W	LCA Hydrograph Without Pumping and With Improved Weir at A8W	LGR Project With Pumping and With Improved Weir at A8W
Existing Levee Low Spot					
Peak Flowrate (cfs)	4,700	4,700	6,100		
Net Volume (AF)	8,300	9,100	9,800		
Engineered 1000-lf Weir					
Peak Flowrate (cfs)				7,600	8,500
Net Volume (AF)				12,200	14,300

i.e. 9,400 cfs going d/s of Alviso Slough

i.e. 9,850 cfs going d/s.

See 1/3/02 memo

Figure 22. Alviso Slough to Cargill Pond A8 Overflow Peak Discharges and Volumes

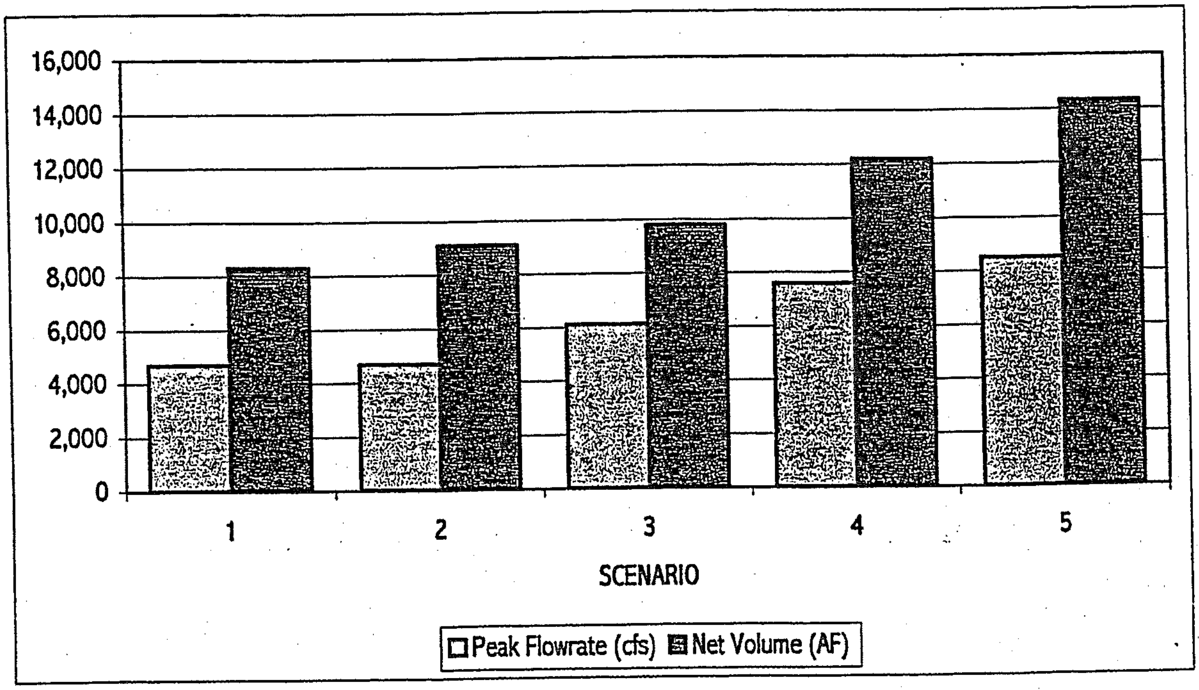


Figure 23. Alviso Slough Water Surface Profile Comparison
Existing Conditions vs. LGR Project Including Interior Drainage

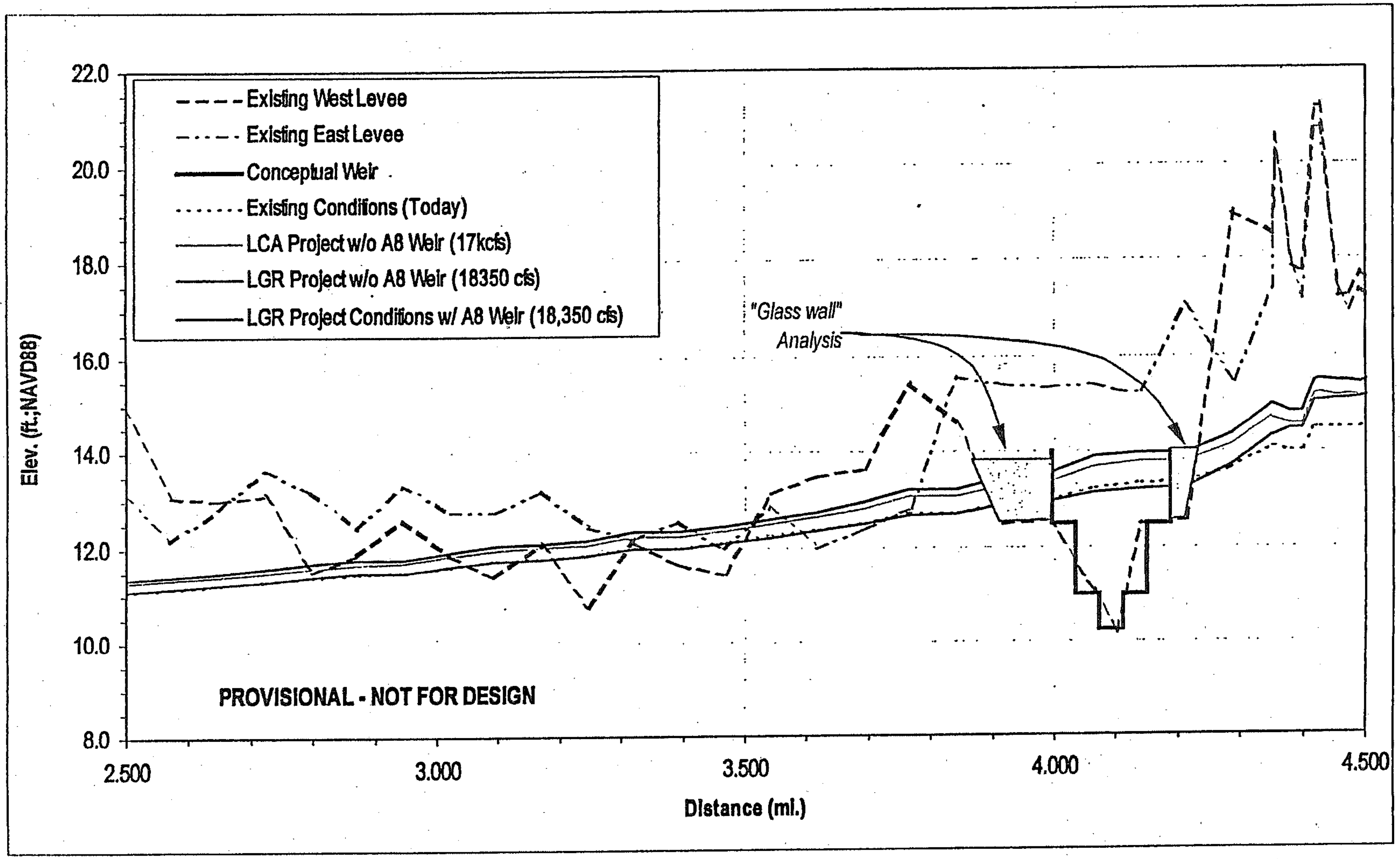
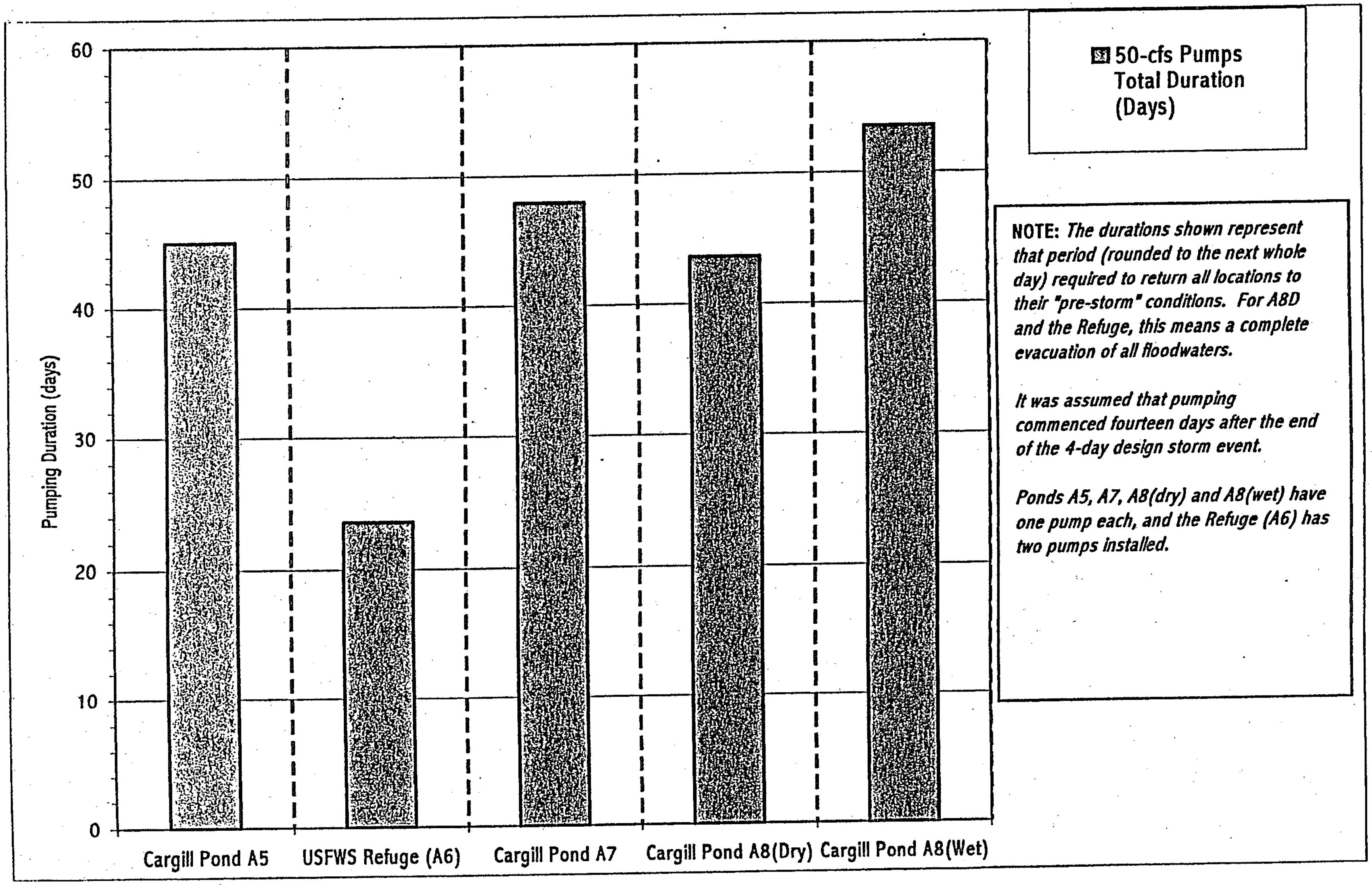


Figure 24. Pump-out Durations for Cargill Ponds A5-A8 and the USFWS Refuge With 50-cfs Capacity Pumping Plants



NOTE: *The durations shown represent that period (rounded to the next whole day) required to return all locations to their "pre-storm" conditions. For A8D and the Refuge, this means a complete evacuation of all floodwaters.*

It was assumed that pumping commenced fourteen days after the end of the 4-day design storm event.

Ponds A5, A7, A8(dry) and A8(wet) have one pump each, and the Refuge (A6) has two pumps installed.

Figure 25. One-Percent Design Hydrograph for Coyote Creek

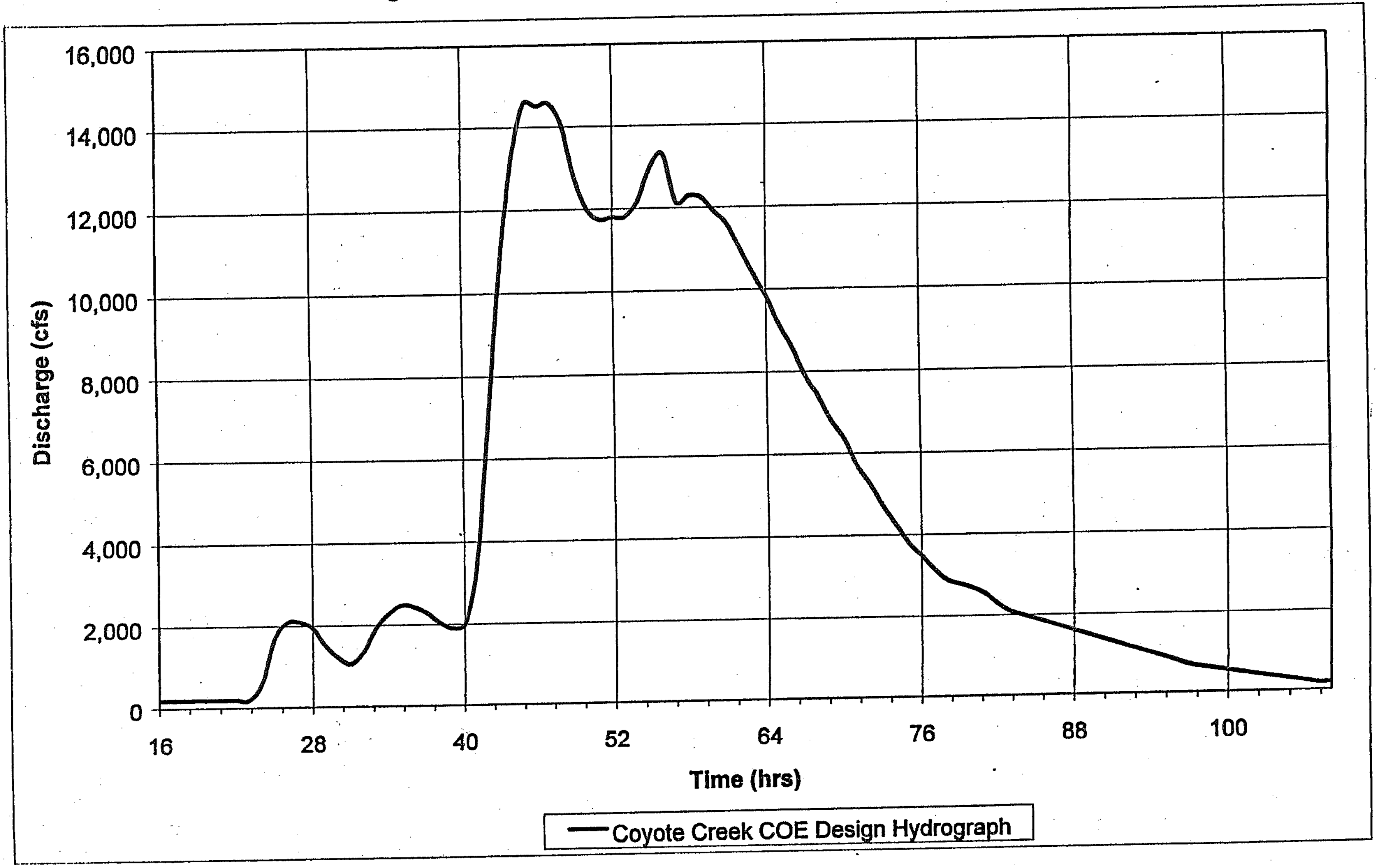


Figure 26. One-Percent Design Hydrographs for Guadalupe Slough Tributaries

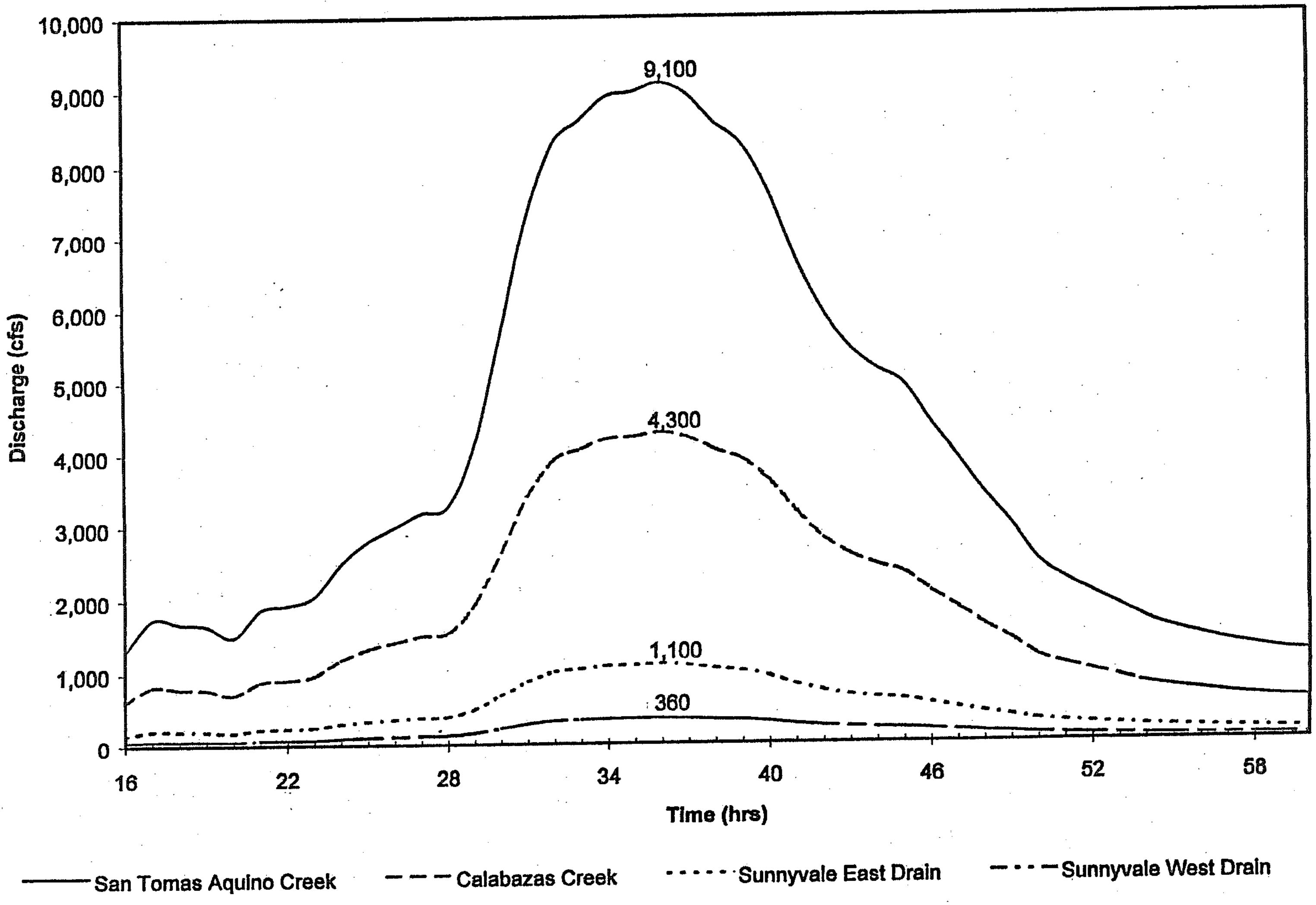
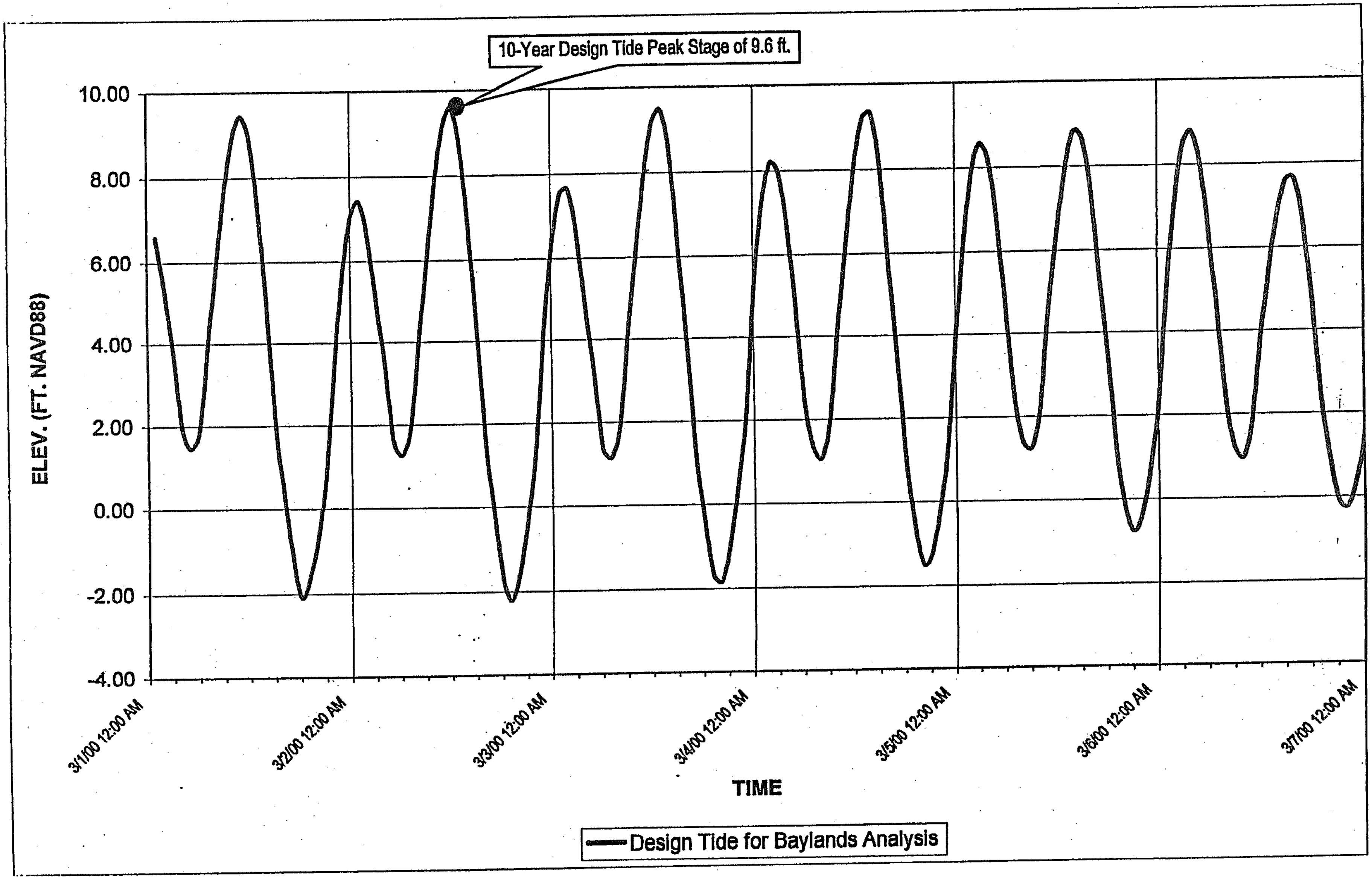


Figure 27. Design Tide at Dumbarton Bridge



10-Year Design Tide Peak Stage of 9.6 ft.

Design Tide for Baylands Analysis

Appendix A

Interior Drainage Investigation within the City of San Jose Watersheds

A-N West, Inc.
Jerome de Verrier, PE, Associate Engineer

Findings of the LGR Project Interior Drainage Study within the City of San Jose Watersheds

Purpose

This appendix presents the findings of the hydrologic analyses of selected watersheds (located in the San Jose) that drain into the Guadalupe River from Interstate Highway 880 to Alviso.

Scope of Work

- Confirm pumping capacities, operational parameters, and outfall data for three City of San Jose pump stations (existing Rincon 1 and Oakmead and proposed Rincon 2 pump stations) discharging into the Guadalupe River
- Provide discharge hydrographs for Rincon 1 and Rincon 2 pump stations generated from the USACE 100-year, 72-hour rainfall event. The Oakmead pump station discharge is estimated to be reasonably represented by the Rincon 2 discharge hydrograph
- Review City of San Jose storm sewer system maps and CH2M HILL survey data between Interstate Highway 880 and Alviso to tabulate all gravity outfalls 36 inches in diameter and larger which discharge into the Guadalupe River
- Review the preliminary Guadalupe River hydraulic model results from Northwest Hydraulics to compare the 100-year water surface elevation at the gravity outfalls with ground elevations in the vicinity
- Provide discharge hydrographs using a USACE 100-year, 72-hour rainfall event for significant San Jose gravity outfalls where hydraulic conditions allow outflow

This information will be used to estimate the impact of these local flows on the LGR Project.

Summary of Findings

Study results are summarized in Tables 1 and 2 below:

Table 1 Pump Station Results

Facility	River Station (P-Line)	Pumping Capacity (cfs)	Tributary Area (sq. mi.)	Approx. Time of Conc. (min)	Peak Runoff (cfs)	Peak Discharge to River (cfs)	Occurrence (hrs)	No. of Pumps
Oakmead Pump Station[1]	8+650	670	2.32	-	-	-	-	-
Rincon 1 Pump Station	11+775	360	0.80	37	245	240	35–38	2/3
Rincon 2 Pump Station	13+500	600	1.31	45	390	480	34–38	4/5

[1] See Pump Station Methodology discussion below

Table 2 - Gravity Outfall Results

Facility	River Station (P-Line)	Outfall Pipe Dia. (in)	Tributary Area (sq. mi.)	Approx. Time of Conc. (min)	Peak Runoff (cfs)	Peak Discharge to River (cfs)	Occurrence (hrs)
Airport Pkwy (Outfall 612)	15+670	54	0.40	36	120	110	34–38
Sonora Dr. (Outfalls 607/608)	16+700	66 & 78	2.00	72	530	510	35–39
I-880 (Outfalls 623/624)	17+600	54 & 30	1.25	64	340	205	35–39

The USACE 1-percent, 72-hour storm did not generate sufficient runoff to exceed the capacity of the pump stations. In our models, not all pumps turned on at the Rincon 1 and Rincon 2 pump stations.

In all cases, the peak discharge to the river flowing from the gravity outfalls was less than the peak runoff. The capacity of the outfall pipe was determined by calculating a backwater starting from the preliminary Guadalupe River peak-water-surface elevations provided by Northwest Hydraulics. Accounting for pipe friction and junction losses, we determined the slope of the energy grade line that would just barely surcharge the storm drain system beyond the low ground elevations within about 2,500 feet upstream of the outfall.

Note that peak Guadalupe River water surface elevations were used to calculate the backwater. In reality, the river may peak at a different time from the local watersheds; therefore, it is possible for the entire peak runoff to pass through the outfall.

Pump Station Methodology

Data and Assumptions. The storm drain systems for those watersheds that drain via the Rincon 1 and Rincon 2 pump stations have been previously modeled using the computer software application SWMM for the *North San Jose Rincon de los Esteros Storm Drain Master Plan* (see below). The Rincon 1 pump station was constructed in 1999 and is currently in operation. The model assumes that the on and off settings of the Rincon 1 pump are approximately two feet lower than the current settings, which were recently confirmed as part of our scope for this study. A-N West has previously recommended that the City of San Jose modify the Rincon 1 operational parameters defined in *North San Jose Rincon de los Esteros Storm Drain Master Plan Final Report,* dated June 1999 by A-N West, Inc., for the City of San Jose.

The final design plans and specifications for the Rincon de los Esteros Phase II (or Rincon 2 pump station as referred to in this report) was submitted to the City of San Jose in September 2001 but has not yet been constructed. The data we are providing assumes that Rincon 2 pump station is constructed in addition to other planned storm drain improvements as outlined in the above-mentioned *Master Plan Report.*

Several City of San Jose pump stations within the scope limits were omitted from study since their discharge capacity is comparatively small to the pump stations studied. These pump stations are listed in Table 3 below including their approximate combined total capacity.

Table 3. City of San Jose Pump Stations and Their Capacities

Facility	Approx. River Station (*P*-Line)	Approx. Pumping Capacity (cfs)[1]
Alviso Pump Station 12	7+090	0.2
Alviso Pump Station 13	7+210	unknown
Summerset	7+690	21
North First Street	8+000	72
Oakcrest Estates	8+340	12
River Oaks	10+970	67
Gateway	unknown	7
Airport	14+575	50
Airport Parkway Station	15+325	10.5
Combined Total Capacity		**240**

[1] Data from *LGR Levee Operation Draft Emergency Action Plan* by SCVWD, 26 September 2001

Storm Water Management Models (SWMMs). In general, for the purposes of the Master Plan study and therefore this study, SWMM allows the user to input basic hydrologic parameters at selected nodes and generates rainfall hydrographs using any of the popular present-day loss models and routing methods. These flows are then routed through an accurately dimensioned network of unique conduits and pumps. Relevant storage such as wet wells or detention basins can be accounted for. The watershed areas that drain through the Rincon 1 and Rincon 2 Pump Stations were previously modeled for the above mentioned storm drain Master Plan study. The models comprised the pump stations and all storm drain pipes and culverts of 30-inch diameter and larger. The pumps for both stations were modeled as nominal 120 cfs pumps either being on or off depending on wet well water surface elevation. Typically, reinforced concrete pipe was modeled with Manning's *n*-values of 0.015 and energy losses were accounted for at junctions and changes in pipe size.

Design Rainfall Event. To be consistent with previous and concurrent studies of the LGR, for both our pumped and gravity outfall discharge calculations, we used the USACE 100-year, 72-hour rainfall distribution. All watersheds studied for this report were located in a region of San Jose having a mean annual precipitation (MAP) of 14.0 inches. The watersheds are of a size range such that the total depth of the storm is calculated by taking 48 percent of the MAP and then distributing this depth throughout the 1-percent rainfall pattern. This translates into a total rainfall depth of 6.72 inches. The USACE 100-year, 72-hour rainfall distribution pattern and total depth calculation is discussed in *Hydrologic Engineering Office Report on Guadalupe River and Coyote Creek, Santa Clara County, California*, USACE, June 1977.

The USACE 100-year, 72-hour storm pattern has a peak intensity of only 0.49 in/hr for 1 hour. Both Rincon 1 and Rincon 2 pump stations were designed to accept the peak discharge generated by a 10-year, 24-hour design storm, which has a much higher peak intensity for shorter duration. This explains why not all pumps turn on at these pump stations even though a less frequent design storm was utilized for this study.

Oakmead Pump Station. No hydrologic or hydraulic model was prepared for this watershed. As an approximation, because Oakmead pump station has similar capacity and number of pumps as Rincon 2 pump station (see table above), the discharge hydrograph of Rincon 2 should be reasonably representative of what could be expected to be discharged from Oakmead. To obtain an accurate discharge hydrograph, a hydrologic/hydraulic model would need to be prepared. This was not considered necessary for this level of study.

Gravity Outfall Methodology

Data and Assumptions. Gravity outfalls that are 36 inches in diameter or larger, located between Alviso and Interstate Highway 880, and discharge into the Guadalupe River under the USACE 100-year, 72-hour storm conditions were tabulated. From this list, three separate significant storm drain systems totaling five outfalls were studied.

It was determined that the 66-inch and 78-inch diameter outfalls at Sonora Drive (*P*-line Station 16+700), drained one watershed and therefore could not be separated. In fact, the outfall pipes intersect each other at the same elevation about 1000 feet upstream from the outfalls.

It was also determined that the 54-inch diameter outfall near I-880 (*P*-line Station 17+600) was part of a large and complicated storm drain network that shared an adjacent 30-inch outfall in addition to 66-inch and 30-inch outfalls upstream of I-880 (beyond the study limits). As the summary chart shows, it was necessary to include the adjacent 30-inch outfall to estimate a reasonable peak flow to the Guadalupe River. However, we were able to reasonably segregate the outfalls upstream of I-880 along with their contributing tributary area and to exclude them from this study.

The study of gravity outfalls upstream of I-880 was out of scope for this study.

HEC-HMS 2.1 (Hydrologic Engineering Center's Hydrologic Modeling System), a computer software application, was used to prepare hydrographs from the watersheds at their outfalls. HEC-HMS is the replacement program for HEC-1.

The City of San Jose storm sewer maps were used to define and measure drainage basin areas and time of concentration (t_c) lengths. It was not part of our scope to define subbasins within the overall drainage basin or to route inflow hydrographs through existing storm drain pipes. Our method was to route all flows to the outfall by using a t_c length from the outfall to the furthest inlet. We assumed a nominal 5-feet-per-second velocity within the storm drain conduits. An inlet time was added to estimate the overall t_c based on criteria set forth from the City of San Jose Storm Drain Design Guidelines: 5 minutes for commercial areas or residential areas zoned for greater than 8 dwelling units per acre and 10 minutes for residential areas zoned for 8 dwelling units per acre or less.

Gravity outfalls to Guadalupe River within the scope limits that were either (1) 36 inches in diameter or less, or (2) could not drain due to the high river water surface elevation relative to ground elevations, were omitted from study. Their discharge seems to be inconsequential in the overall LGR Project because of their limited capacity. These outfalls are listed in Table 4 below including their total combined outflow.

Table 4. San Jose Outfalls Omitted from Study

SJ Outfall No.	Approx. River Station (*P*-Line)	Outfall Pipe Dia. (in)		Approx. Max. Flow During Peak River WSEL (cfs)	Reason not Studied
		CSJ Data	CH2M HILL Data		
576	13+650	36	36	31	Outfall small–low flow
680	14+608	78	72	-	River WS high relative to basin ground elevations–can't drain (assume flapgate closed)
681	14+615	54	54	-	River WS high relative to basin ground elevations–can't drain (assume flapgate closed)
683	14+800	36	36	-	River WS high relative to basin ground elevations–can't drain (assume flapgate closed)
686	15+700	54	54	-	River WS high relative to basin ground elevations–can't drain (assume flapgate closed)
611	17+440	36	-	48	Outfall small–low flow
Total				79	

Losses due to Infiltration. Infiltration is estimated based on land use, soil type, and antecedent moisture conditions. We utilized the Soil Conservation Service (SCS) Curve Number method to account for infiltration (Schaaf & Wheeler also used this method for their study of the Santa Clara outfalls). SCS soil maps indicate that the study area is underlain by soils classified as Hydrologic Soil Group *D* and the Antecedent Moisture Condition was assumed to be $\mathrm{I}^{1}/_{2}$. We utilized the City of San Jose Storm Sewer Maps to determine land-use type limited to either low density/high density residential (CN = 82 assuming 1/3 of area is high density) or commercial (CN = 91). Since the CN values are based on land-use type, the percent of impervious area was assumed to be zero. Again, since the CN values are based on an assumed antecedent moisture condition, initial infiltration was assumed to be zero.

Unit Hydrograph. We used the Clark dimensionless unit hydrograph to generate the runoff hydrographs (as Schaaf & Wheeler, etc.). This method requires two parameters: t_c and a storage coefficient, R. The method used to calculate t_c is explained above. R, in units of time, is estimated from t_c by the following formula (where C generally ranges between 0.1 and 0.5 for urbanized areas):

$$C = \frac{R}{t_c + R}$$

We used a C equal to 0.3, which calibrated well with the peak runoff generated in our SWMM mentioned above.

Appendix B
Interior Drainage Investigation within the City of Santa Clara Watersheds

SCHAAF & WHEELER
Charles D. Anderson, PE, Principal

Study Purpose

This appendix presents the findings of a preliminary hydrologic investigation undertaken regarding local drainage from Santa Clara tributary to the LGR between Interstate 880 and Highway 237. Refinements have been made to correct antecedent moisture conditions typical of 72-hour storms and to utilize design water surface information recently made available. The study of gravity outfalls upstream of I-880 was not in the scope for this study and floodplain mapping and interior flooding analyses were not part of this investigation.

Local drainage is pumped into the river or drains by gravity outfall with flapgate protection. This analysis is the first step in a more comprehensive look at the potential for coincident interior drainage and its impact on the LGR Project. The basic focus of this work is twofold:

- Confirm pump station capacities and operational parameters within Santa Clara
- Provide preliminary estimates of pump station and gravity outfall discharge hydrographs during the design 72-hour, 1-percent storm event as previously prescribed by the Corps of Engineers. This information will be used by others to assess project impacts resulting from additional discharges into the Guadalupe River downstream of Interstate 880.

Depending upon that impact assessment, the work described herein may be refined and used to gage the impact of potential emergency operating plans on local drainage conditions behind the Guadalupe River levees. This report also discusses additional information and analyses that would be needed to better examine local drainage issues.

Summary Of Findings

Existing drainage facilities in Santa Clara appear to accommodate the design 72-hour, 100-year precipitation event on the LGR, with the exception of the Laurelwood pump station, which limits discharge to its maximum pumping capacity, and the Trimble Road outfall, where discharge capacity is limited by river stage. Table 1 lists the pertinent drainage facilities in Santa Clara, the approximate river station at their outfall, peak local runoff to the facility, peak discharge to the river, the time of peak discharge, and in the case of pumping facilities, how many pumps are in operation at the time of peak runoff.

Table 1. Summary of Santa Clara Facilities

USACE 72-hour, 100-year Storm

Facility	River Station	Peak Local Runoff (cfs)	Peak Discharge to River (cfs)	Timing of Peak Discharge (hours)	No. of Pumps in Operation
Eastside Pump Station	264+00	220	100	32 - 56	3 of 3
Fairway Glen Pump Station	332+00	160	170	35 - 42	2 of 3
Lickmill Pump Station	386+00	200	230	36 - 39	3 of 3
Nelo-Victor Pump Station	410+00	90	110	35 - 38	2 of 3
Laurelwood Pump Station	425+00	180	130	35 - 50	3 of 3
Trimble Outfall	460+00	350	280	37 - 39	n/a

(The referenced information applies *only* to the USACE storm pattern. Also, the analysis reflects an increase in the Nelo-Victor pump station's capacity from 60 cfs to 160 cfs by winter 2003.)

Background

When the USACE estimated design 100-year discharges for the LGR, their analysis stopped at the river's confluence with Los Gatos Creek, so the flood protection project is currently designed to carry 17,000 cfs with FEMA-level freeboard. However, significant areas are tributary to the Guadalupe River downstream of Los Gatos Creek, both in Santa Clara and San Jose. Much of this drainage area is protected by levees. Also, the natural topography, which tends to fall away from the river, has necessitated the construction of several pumping facilities.

The current design peak discharge does not allow for additional runoff to be pumped into the river without compromising freeboard. Consequently, one potential design element of the LGR Project is to develop an emergency action plan (EAP) and emergency operating plan (EOP) to control the timing and rates of interior pumping to the LGR during extreme runoff conditions.

Prior to developing such plans, however, the Santa Clara Valley Water District (District) and its consultants need to evaluate the operation of these local facilities in light of two factors:

- How local hydrology and the timing of pumped discharges affect river flow and design freeboard downstream of Los Gatos Creek.
- Changes to the risk of local flooding (duration and depth of ponding) that might result from implementing the EAP and EOP during a major runoff event on the LGR. Eventually this type of analysis will need to be performed to obtain a letter of map revision from FEMA.

After a brief discussion of Santa Clara's drainage facilities tributary to the LGR, we developed the preliminary methodologies presented herein.

Drainage Facilities

Six major outfalls drain Santa Clara's tributary areas to the LGR. At five of these outfalls, stormwater pumps are available to lift water against high LGR stage. In addition drainage basins directly tributary to the LGR, some overflow from the Rambo and Gianera basins, which normally drain to San Tomas Aquino Creek, are intercepted by Eastside basin storm drains and pumped into the Guadalupe River. Table 2 summarizes each drainage area.

Table 2. Summary of Interior LGR Drainage Basins in Santa Clara

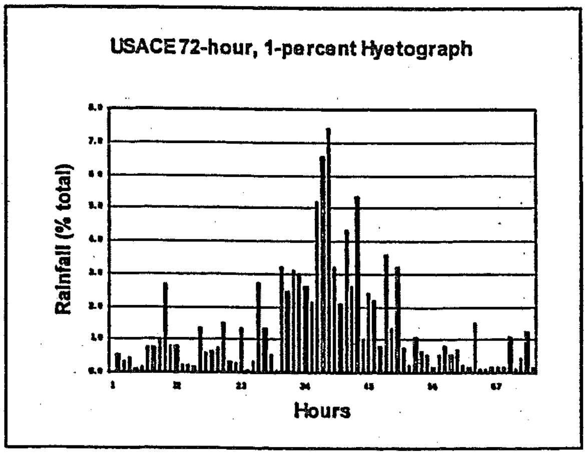
Facility	River Station	Tributary Area (mi2)	Total Pumping Capacity (cfs)	Storage (ac-ft)	Standby Power
Eastside Pump Station	264+00	0.91	100	6.5	no
Fairway Glen Pump Station	332+00	0.65	250	—	yes
Lickmill Pump Station	386+00	0.94	235	—	yes
Nelo-Victor Pump Station	410+00	0.26	160	—	yes
Laurelwood Pump Station	425+00	0.93	130	—	yes
Trimble Outfall	460+00	1.79	n/a	n/a	n/a

Most of the pump stations lack a standpipe system or discharge box to provide constant pumping heads, so coincident tailwater in the Guadalupe River could significantly affects pump performance and therefore discharge to the river. For the purpose of this preliminary analysis, the design 1-percent water surface profile provided by CH2M HILL is used to evaluate pump-station and gravity-outfall capacities.

Methodology

In order to examine pump and basin operation under various scenarios, a design discharge hydrograph is necessary to model local runoff into the basin. Hydrologic analyses utilize information previously gathered for the City of Santa Clara and are modified as needed to reflect conditions at the site.

Design Storm Pattern. To evaluate tributary basin behavior and pump operation under different conditions, estimates of stormwater volume are required. To remain on a consistent basis with previous LGR analyses, the USACE design 72-hour, 100-year storm pattern is used to distribute rainfall. The design 72-hour rainfall depth is 6.72 inches. This pattern, which appears to be the Christmas 1955 storm or similar to it, is shown to the right. One way to refine the analysis would be to examine the merits of a further reduction in 72-hour depth to reflect additional tributary area downstream of Interstate 880.



Runoff Hydrographs. To evaluate collection system facilities where the storage of runoff is important (e.g., basin detention), a synthetic unit hydrograph procedure is used with aforementioned rainfall patterns to produce the requisite runoff hydrographs through a process known as convolution. A unit hydrograph is defined as the basin runoff produced by one inch of rainfall excess applied uniformly over the basin over that unit of time. The Clark dimensionless unit hydrograph is established based on two parameters, t_c, which is equal to the time of concentration (in hours) for that basin, and R, a storage coefficient (in hours) that modifies the peakedness of the unit hydrograph. R is related to t_c by the following ratio which generally ranges between 0.1 and 0.5 within impervious (urbanized) areas:

$$C = \frac{R}{t_c + R}$$

Times of concentration for individual storm drain systems have been calculated, either by Schaaf & Wheeler or the City of Santa Clara, using the Rational Formula.

Infiltration. Direct runoff is equivalent to precipitation in excess of the soil's infiltration capacity. This is based on soil type, land use, cover, and antecedent moisture conditions (i.e., how saturated the soil is at the beginning of the storm event). This analysis uses the Soil Conservation Service (SCS) Curve Number methodology. Table 3 presents SCS Curve Numbers for various existing land-use types for both Antecedent Moisture Condition (AMC) II, and for AMC I½, which we have found to calibrate reasonably well to local stream gage frequency analyses for the 100-year discharge with a 72-hour storm. SCS soil maps for Santa Clara County indicate that most areas tributary to the LGR are underlain by soils classified in Hydrologic Soil Group *D*.

Table 3. SCS Curve Numbers

Land Use	CNAMCII	CNAMCI½
Residential	87	80
High Density Residential	92	87
Commercial	95	91
Golf Course	84	76
Landfill / Open	94	90

Storage Routing. Kinematic wave routines available in HEC-1 are used to route flows down streets (Manning's $n = 0.020$) or in storm drain pipes ($n = 0.013$). Reservoir routing is used to analyze the Eastside detention basin.

Pump Station Operation. Detailed operating parameters have been incorporated into the analyses of the Eastside and Lickmill facilities. Since the Eastside relies heavily upon detention storage, this information is critical. However, as shown on the attached discharge plot for the Lickmill pump station, actual pump cycling is not important on the macro-scale, since pump cycle times are for the most part, less than 15 minutes, which is the computational time step.

Gravity Outfall Above Trimble Road. Local runoff is discharged from the vicinity of De La Cruz Boulevard through roughly 2,500 feet of parallel 48-inch and 72-inch storm drains into the Guadalupe River near Highway 101 upstream of Trimble Road. (River Station 460+00, or Project Station 14+008 in metric.) Based on information taken from the City of Santa Clara's storm drain block maps, the release point for water to flow to the north from De La Cruz is approximately 36 feet NGVD. The parallel RCP drains are equivalent to a single 80.4-inch diameter drain. The design 1-percent water surface elevation at Station 14+008 is 9.93 m NAVD, which can be converted to 39.82 feet NGVD; thus, there are 6.2 feet of available head at De La Cruz to drive water into the Guadalupe River, even at maximum river stage.

Assuming that water is at the top of curb on De La Cruz Boulevard and accounting for the loss of one velocity head upon discharge into the river, the capacity of the 72-inch outfall is approximately 210 cfs, and the capacity of the 48-inch outfall is about 70 cfs. The total estimated gravity discharge at peak design river stage is thus 280 cfs.

Key Assumptions Inherent with These Analyses

The following key assumptions are inherent with these analyses:

- The USACE design hydrology (72-hour, 100-year precipitation event) was used to estimate the amount of rainfall occurring within the LGR study area. No precipitation adjustments or further depth-area reductions were made.
- The study of gravity outfalls upstream of I-880 was not in the scope for this study.
- Floodplain mapping and interior flooding analyses were not part of this investigation.
- Guadalupe River tailwater does have an effect on pumping rates during the design runoff event. This effect was addressed for the Eastside and Nelo-Victor pumping plants, but none of the others. To do so would require detailed hydraulic analyses for the pump station discharge pipes.

FILE
50148.0706

FAXED
4-30-02

Technical Memorandum

To: Ron Duke, Gail Seeds and Dave Von Rueden

CC: Steve Centerwall

From: Loren Murray and Bob MacArthur

Date: 04/30/02

Re: "Order-of-magnitude Estimate" of New Chicago Marsh Flooding Depths

---

Ron, Gail and David:

NHC performed a quick assessment to compare depths of ponding in New Chicago Marsh for "exiting conditions" and "with-project conditions." Attached is a listing of the assumptions and boundary conditions used for both conditions and the estimated ponding depths in New Chicago Marsh and Alviso after the fourth day of the design event.

Depths of ponding above present marsh elevations in New Chicago Marsh (NCM) following the 4-day design event:

Existing conditions (assumes no leaks from Co. Marina)	**Depth in NCM = 6.0 feet**
	Depth in Alviso = 7.0 feet
With-Project conditions (no leaks from Co. Marina)	**Depth in NCM = 2.6 feet**
	Depth in Alviso = 3.6 feet

These results are considered order-of-magnitude quality only due to the quality of available topography and limitations placed on the estimated amount of runoff entering NCM from the North first Street corridor. More detailed analysis of the amount of interior drainage that is likely to enter NCM and Alviso during the design event is required to improve the reliability of these estimates, but is beyond the scope and time available for this order-of-magnitude assessment.

If you have questions or further needs, please call me or Loren Murray at (916) 371-7400.

Sincerely,

Northwest Hydraulic Consultants, Inc.

Robert C. MacArthur

Robert C. MacArthur, P.E.
Attachments

northwest hydraulic consultants, inc.	**DATE** 4/29/02	**BY** LAM	**CHK** 1/5
PROJECT LGRFPP		**JOB No.** 50198	
SUBJECT – CURSORY REVIEW OF NEW CHICAGO MARSH FLOODING			

THE FOLLOWING IS A CURSORY ANALYSIS OF NEW CHICAGO MARSH:

EXISTING CONDITIONS

- CO. MARINA LEAKS FIXED.
- LGR HYDROGRAPH PEAKS AT 14,000 CFS; REMAINDER GOES DOWN RINCON DE LOS ESTEROS VIA N. FIRST ST.
- RDLE INFLOW BASED ON PREVIOUS LOCAL RUNOFF CALCS. (FIGURE 1)
- ASSUME THAT NCM PUMPS ARE INEFFECTIVE AT EVACUATING WATER DURING 4-DAY SIMULATION.
- EXCESS LGR FLOWS ARE BASED ON "LCA" HYDROGRAPH
- DURATION OF ANALYSIS IS 4-DAYS; NOTHING ANALYZED BEYOND 4-DAYS.

RESULTS

- BOTH NCM AND ALVISO FLOOD TO AN ELEVATION OF ≈ 7 FT. (DEPTH IS DEPTH COULD BE HIGHER GIVEN MORE TIME.)
- INUNDATION DEPTH (FT.):

Δ ALVISO	7.0 FT.
Δ NCM	6.0 FT.

(FIGURE 3.)

PROJECT CONDITIONS:

- CO. MARINA LEAKS FIXED.
- LGR HYDROGRAPH INCLUDES PORTION OF LOCAL N. FIRST ST. RUNOFF UP TO STORM-DRAIN SYSTEM CAP. (18,350 CFS)
- RDLE INFLOW EQUALS RESIDUAL N. FIRST ST. RUNOFF > STORMDRAIN SYSTEM CAPACITY. (FIGURE 2)
- DISREGARD NCM PUMPING EFFECTS.
- SIMULATION DURATION IS 4-DAYS; SAME AS IN THE "EXISTING CONDITIONS."

- BOTH NCM AND ALVISO FLOOD TO AN ELEVATION OF APPROX. 3.6 FT.
- INUNDATION DEPTH (FT.):

Δ ALVISO	3.6 FT.
Δ NCM	2.6 FT.

(FIGURE 4.)

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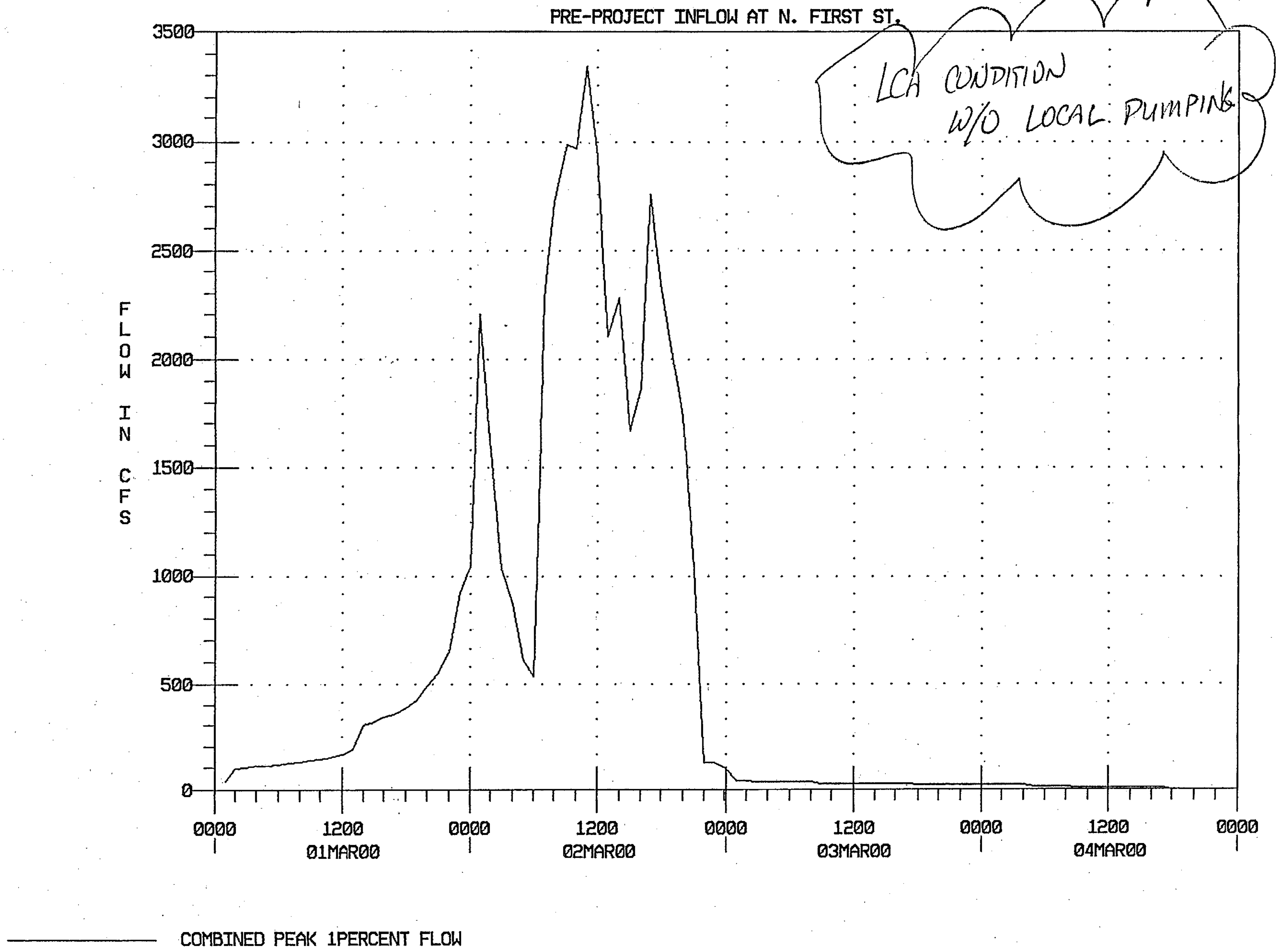

LCA CONDITION
W/O LOCAL PUMPING

FIGURE 1

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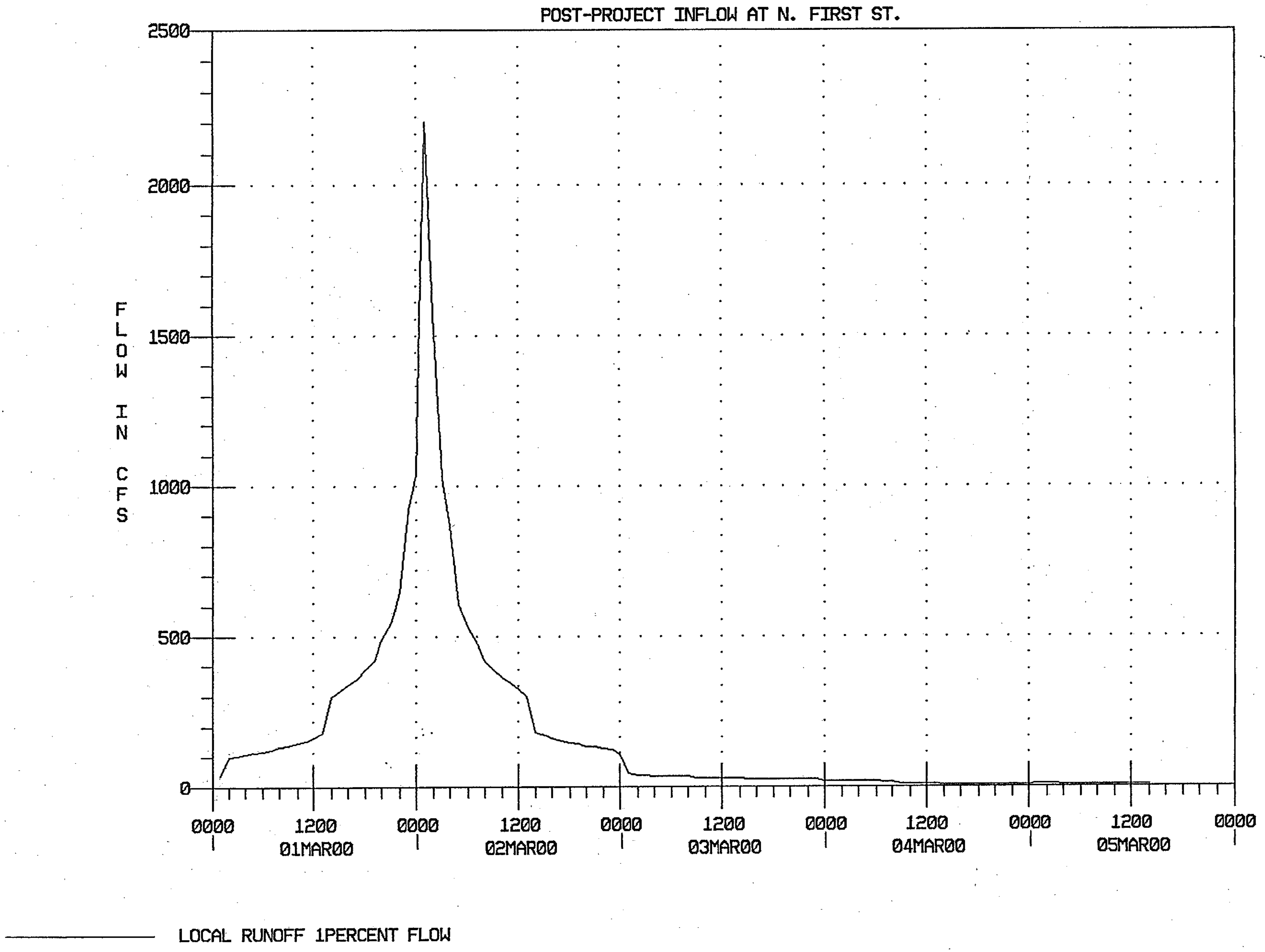

FIGURE 2

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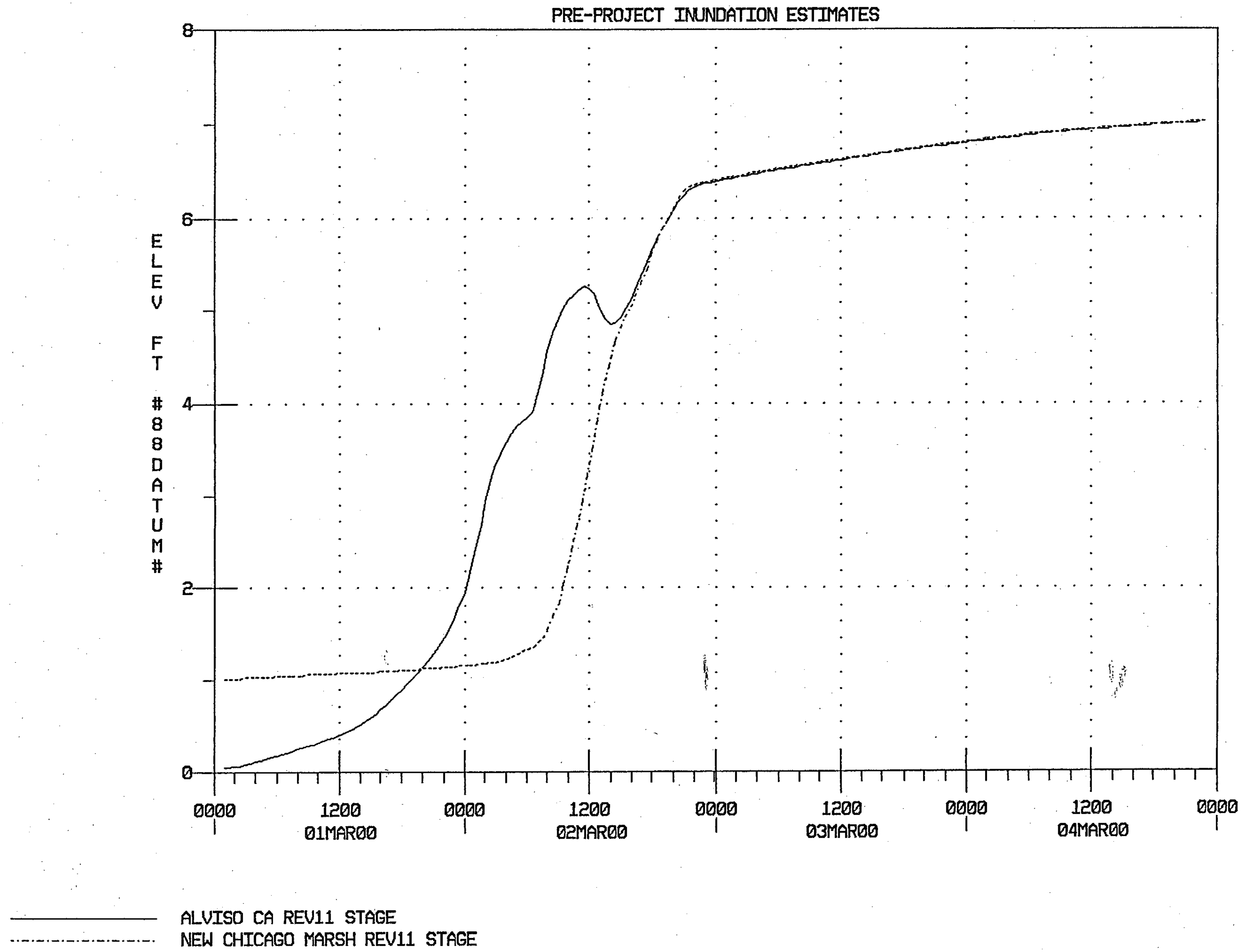
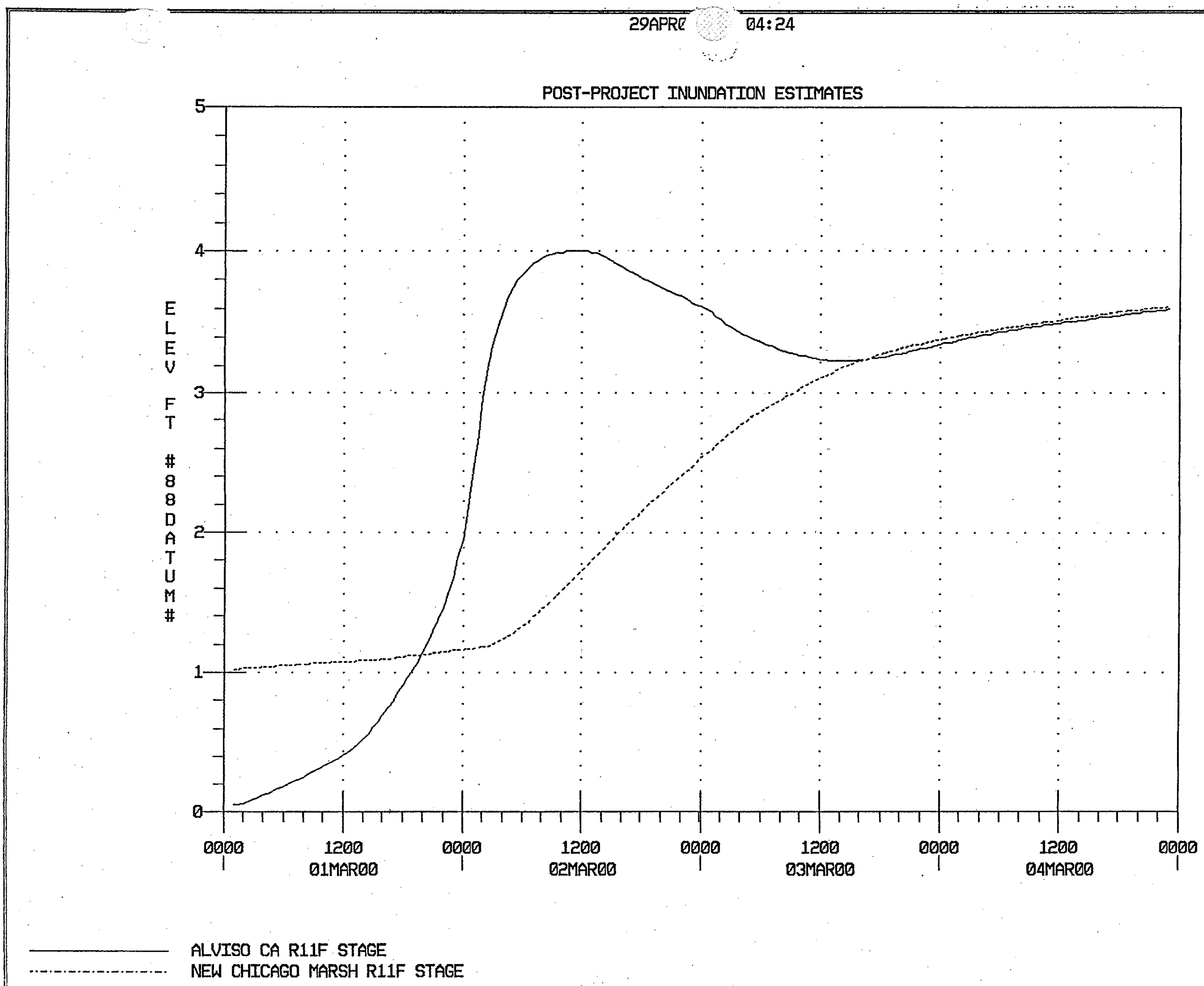


FIGURE 3.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POST-PROJECT INUNDATION ESTIMATES
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ALVISO CA R11F STAGE
NEW CHICAGO MARSH R11F STAGE

FIGURE 4.

northwest hydraulic consultants

Memo

FILE
5012
CORRESP

To: David Von Rueden, CH2M Hill, San Jose

From: Loren Murray, NHC

CC: Robert MacArthur, NHC

Date: April 11, 2002

Project: Lower Guadalupe River Flood Protection Project – Supplemental Baylands Hydraulic Assessment Incorporating March 2002 Field Surveys

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Subject: Update on Preliminary Modeling to Reduce Project-induced Impacts on the USFWS Refuge.

Summary of Findings

The volume of floodwaters entering Ponds A5, A7 and A8 over such a short time period overwhelms the capacity of the interior ponds resulting in spillage both into the adjoining USFWS Refuge as well as back out into both Alviso and Guadalupe Sloughs. Attempts to alleviate the Refuge flooding by introducing outfall weirs on both Alviso and Guadalupe Sloughs to shunt excess waters back into the sloughs from A5-A8 were not successful in protecting the Refuge. In addition, attempting to use uni-directional culverts to shunt excess floodwaters back into the sloughs to protect the Refuge were also unsuccessful. The hydraulic head between the inundated Cargill ponds and the Sloughs is not sufficient to adequately drain off floodwaters before they spill into the Refuge.

The low spots in the Refuge levee are on the order of approximately 10.2-10.3 ft. Sufficient floodwaters spill over the A8W weir to fill all the interior ponds to an elevation of 11.0± ft. Attempts to lower the interior ponds' commingled water surface to something below 10.2-10.3 through the use of weirs or culverts doesn't work very well. It doesn't work well with culverts because the head differential between the ponds and the sloughs is so low that we don't get effective flow through the culverts (much of their cross-section is submerged during the 4-day storm event). And, it doesn't work well with outfall weirs because the weir crests must be at least 10.0' elev. in order to not allow regular tidal inflow into the ponds during high tides. (That's why lengthening weirs to 500-lf each for each slough didn't help; they only had about a maximum of one foot of water going over them at their peak outfall condition.) The Refuge is still flooded by 0.5-1.0 feet of water even with either (a) several culvert outlets or (b) lengthy outlet weirs in-place.

At the moment, it appears that at least the low spots (3-5) across the Refuge levee that are below elevation 11.0 feet NAVD88 need to be filled to prohibit A5-A8 floodwaters from spilling into the Refuge. The only other option (to reduce the stage in the A5-A8 ponds) would be to reduce the overflow spillage into A8W. (At the present, I'm still using the 1,000-lf weir.) This would result in more flows continuing downstream in Alviso Slough, thus raising the water surface profile above the existing (pre-project) water surface profile, and possibly impacting the habitat and/or species along the slough. The Water District needs to instruct us as to whether to impact the Refuge property (and possibly have to do some pump out after rare events), or to send more water down Alviso Slough and do the assessment by HTH and J&S to determine if there is any impact in the Slough. Any/all overtopping locations on slough levees remain extremely vulnerable to scour and failure unless they are armored or protected in some fashion. The other option is to fill certain overtopping locations in, and construct a controlled outlet at a location of our choosing, and at appropriate dimensions to manage the design flood.

I suggest we have a quick telephone conference call with Dennis to decide how to proceed. I can be available tomorrow afternoon for a conference call with you and Dennis, HTH and whoever else is needed. To answer a question you posed in your 4/09/02 email regarding when we could have the final configuration of the Alviso weir done, we can't finalize that particular mitigation component until the District has decided what other components will be packaged with it. The weir configuration is dependent upon how floodwaters are managed in A5-A8, whether or not improved outfalls are included, whether or not the Refuge will temporarily store floodwaters, etc. They are all dependent variables. Once we know what pieces make up the baylands mitigation, we can give you more specific results.

Sincerely,
Northwest Hydraulic Consultants, Inc.

Loren A. Murray

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northwest hydraulic consultants

Memo

To: David Von Rueden, CH2M Hill, San Jose
From: Loren Murray, NHC
CC: Robert MacArthur, NHC
Date: April 4, 2002
Project: Lower Guadalupe River Flood Protection Project – Supplemental Baylands Hydraulic Assessment Incorporating March 2002 Field Surveys

Subject: Using Outlet Weirs to Reduce/Eliminate Project-Induced Flood Inundation of the USFWS Refuge Property (Formerly Cargill Pond A6).

Summary of Findings

The use of "outlet" weirs only on Alviso and Guadalupe Sloughs does not eliminate the Project-induced inundation of the USFWS Refuge property. Reconnaissance-level hydraulic analyses indicated that these outlet weirs could not adequately reduce the flood volume entering the interior region[1] sufficient to avoid flooding the Refuge. Outlet weir lengths up to 500 linear-feet each for Guadalupe Slough and Alviso Slough were tested, but found to unsuccessfully remove the flood threat to the Refuge from floodwaters spilling out of the Guadalupe River / Alviso Slough. Use of outlet weirs would still require raising the Refuge levee to at least elevation 11.0 ft. (NAVD88). The outlet weirs would also require significant armoring to guard against scour or damage from overtopping flows. If the USFWS requires freeboard as an added measure of protection against uncertainties, then the Refuge levee would have to be even taller.

Analysis

The implementation of the Downtown and Lower Guadalupe River (LGR) Projects will send approximately 4,100 acre-feet of additional[2] floodwaters into the baylands downstream of UPRR at Alviso, California. To mitigate these hydraulic impacts, flow management concepts (overflow weirs, pumps, unidirectional outlets, etc.) have been tested to provide the Santa Clara Valley Water District (District) with more predictable flood management in the baylands.

Existing Conditions. — Under present-day, "existing" conditions, excess flows in Alviso Slough spill over a low swale in the Cargill levee across from the town of Alviso, inundating portions of Cargill Ponds A5, A7 and A8. According to the analysis, the Refuge is not presently inundated under existing conditions. (Approximately 9,100 acre-feet of the 10,627 acre-feet inundating Ponds A5, A7 and A8 under existing conditions comes from the Guadalupe River.)

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1. The area represented by Cargill Ponds A5, A7 and A8 as well as the USFWS Refuge.
2. The existing conditions LGR hydrograph volume at is estimated at approximately 49,500 acre-feet, and the with-LGR Project Design hydrograph volume at UPRR is estimated at 53,600 acre-feet.

Project Conditions. — Under current Project mitigation considerations, excess Guadalupe River flood flows spill across an engineered weir out of Alviso Slough and into Cargill Pond A8. This weir reduces the Project's Alviso Slough water surface profile downstream of the weir to approximately the existing, "pre-project" conditions. As floodwaters spill over the weir filling Pond A8, these floodwaters then cascade (over low, interior levees that divide the ponds from one another) into Ponds A5 and A7. A recently improved levee separating the Refuge from Ponds A5 and A7 prohibits inundation of the Refuge until floodwaters in A5, A7 and A8 exceed approximately elevation 10.1 feet (NAVD88). Unfortunately, Project conditions contribute sufficient flood volume through Alviso Slough to Ponds A5, A7 and A8 such that these ponds fill to an estimated height of between 11.0 – 11.5 feet (NAVD88). At that "topped out" water surface elevation, approximately 1.5 feet of inundation occurs in the Refuge as a result of the Project. (See Figure 1)

This analysis looked at leaving the present Refuge levee untouched, and including outlet weirs to Alviso and Guadalupe Sloughs near the Refuge levee in an attempt to shunt excess floodwaters back into the sloughs rather than allowing it to flow into the Refuge. Results of the hydraulic analysis indicate that it is infeasible or unlikely that these "outlet" weirs could eliminate the Project-induced inundation of the Refuge. In order to prohibit tidal impacts to the interior ponds during high tide periods, the minimum "outlet" weirs must be at or above approximately 10.0 feet. The water surface elevation in the interior ponds when the Refuge levee starts to leak is somewhere between 10.1 and 10.3 feet; essentially within a half-foot of the elevation of the "outlet" weir(s). These weirs would need significantly greater length to completely eliminate the inundation potential to the USFWS Refuge.

The results are preliminary, and not suitable for design purposes. These results assume structural integrity of all affected levees (whether along the sloughs or interior to Cargill ponds), and assume that other, unprotected overtopping locations along the slough levees do not fail during the duration of the storm. These results exclude effects of wind-wave setup which could affect performance of the A8 weir, as well as the performance of the "outlet" weirs. These results do nothing to reduce or eliminate Project-induced flooding to other private or Federal lands (Cargill Ponds A3, A9-A15) contiguous to the area between Alviso and Guadalupe Slough. The analyses for Project conditions have not quantified the hydraulic effects on the water surface profiles of the sloughs as ~~a~~ result of including these outlet weirs as Project mitigation. At 500-lineal feet each, the outlet weirs discharge approximately 1,200 cfs additional flowrate into each of the sloughs; a contribution of more than ten percent (10%) additional flow in the sloughs as compared to existing (pre-project) conditions.

Recommendations

Options remaining for further consideration could include:

- Letting the USFWS Refuge flood from the rare, infrequent events, to be pumped out by the District after the flood has passed;
- Raise the USFWS Refuge levee to a sufficient height (at least 11.5 ft. NGVD88 before freeboard) to reject Project-induced flooding into the Refuge;
- A combination of Refuge levee raising and "outlet" weir(s).

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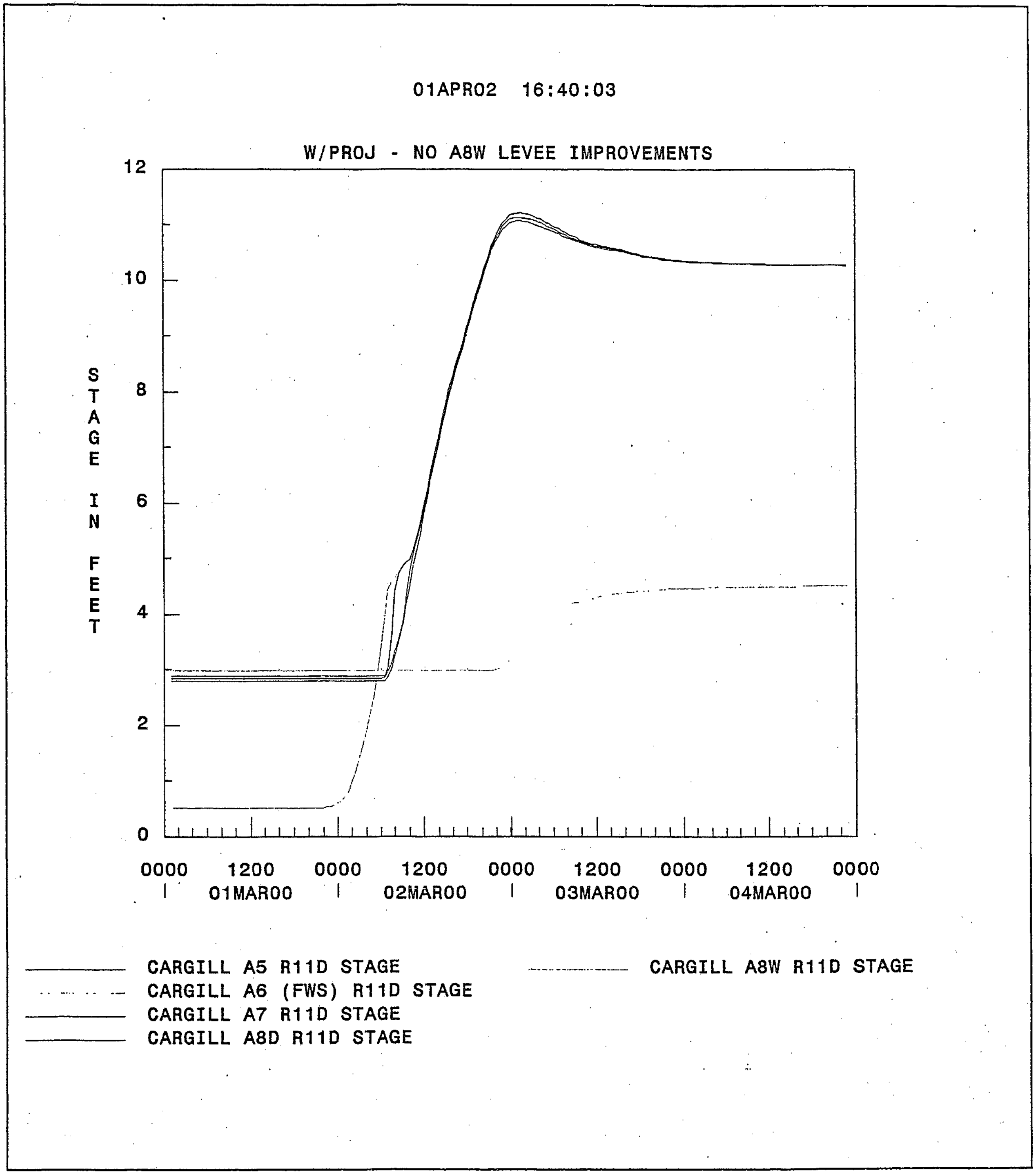

Figure 1. – Project-induced inundation of Cargill Ponds A5, A7 and A8 as well as the USFWS Refuge (A6).

Technical Memorandum

northwest hydraulic consultants
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west sacramento, ca 95691
(916) 371-7400
(916) 371-7475 (fax)

Date:	February 27, 2002	Project:	A2248 / A2248A
To:	David Von Rueden and Erika Gomez		
Company/Agency:	CH2M Hill, San Jose, California.		
From:	Robert C. MacArthur and Loren A. Murray, nhc		
Cc:	Jeff Johnson, nhc		
Project:	Lower Guadalupe River Flood Protection Project, Summary of Recent Supplemental Baylands Reconnaissance Analysis, nhc 50198.		
Subject:	Summary of Technical Information requested during the 10 December 2001 meeting with Cargill.		

Representatives from the SCVWD, CH2M Hill (CH2M), Northwest Hydraulic Consultants (NHC), Schaaf and Wheeler and Cargill Salt met at Cargill's offices in Freemont at 10:00 a.m. on December 10, 2001, to discuss issues pertaining to the District's Draft EIR and Engineer's Report. The following items were discussed:

1. Baylands modeling approach, assumed boundary conditions, including tides, flows, channel capacity, model extent (aerial coverage), and channel geometry;
2. Definition of "existing" or baseline conditions, "with-LGR Project" Conditions, and hydraulic criteria used in the analyses;
3. Baylands mitigation alternatives that have been considered and/or evaluated by the District and CH2M.

During the discussions, it became apparent that Cargill and Schaaf and Wheeler were unable to find the level of detail they needed to address their concerns for the above topics in the Draft EIR or Engineer's Report. A substantial Reconnaissance study and additional modeling analyses were completed by the study team to support the ER and EIR. However, many of the details were not attached with the ER or EIR. Therefore, this memo is intended to provide additional technical information on Baylands studies completed to date to supplement that which is found in the EIR or Engineer's Report. All attending the meeting agreed to review these materials and that they would meet again if necessary to discuss remaining issues or questions.

1. Analysis Approach and Boundary Conditions

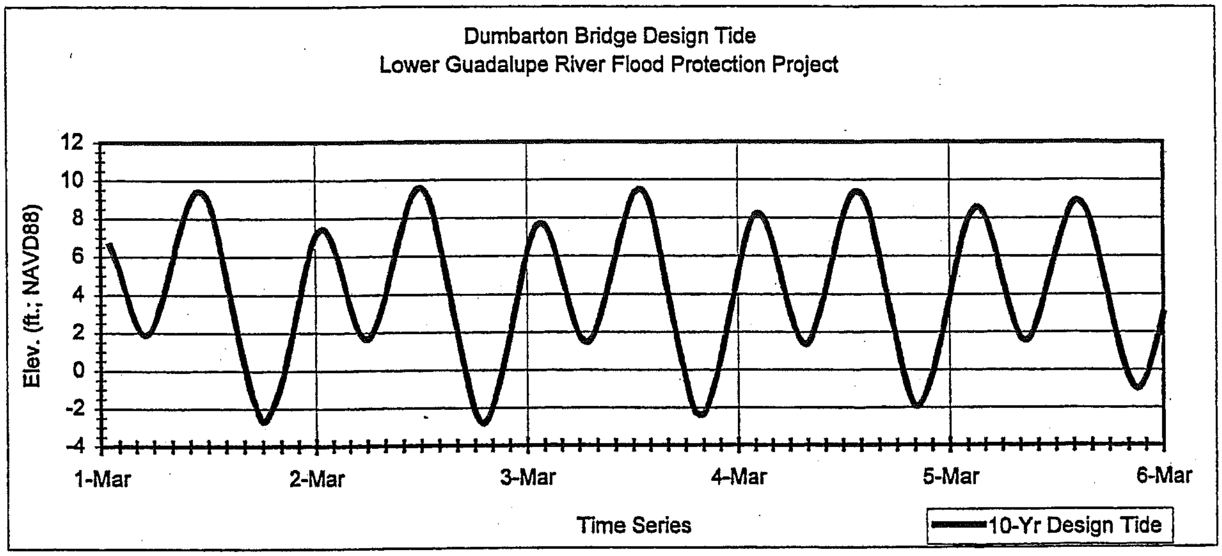
The baylands study area encompasses some twenty-five± square miles and is shown in Figure 1. An unsteady, one-dimensional UNET model was developed to simulate the hydrodynamic characteristics of the baylands study area. Figure 2 shows potential flood-prone areas (treated as storage cells in UNET modeling), local tributaries, and identifies commonly used names for specific areas (Cargill ponds, refuges areas, etc.). Figure 3 is a schematic diagram of how the UNET model represents various hydrologic and hydraulic components of the baylands study area.

The model boundary conditions for the baylands study area include:

- The downstream boundary condition for the baylands model is the South San Francisco Bay tide at Dumbarton Bridge;
- The upstream boundary condition for Coyote Creek inflow is a four-day, single-event flood hydrograph;
- The upstream boundary condition for Alviso Slough inflow is the Corps of Engineers' four-day, single-event flood hydrograph from the Lower Guadalupe River;
- The upstream boundary condition for Guadalupe Slough is a four-day, single-event hydrograph on each of four tributaries delivering runoff into Guadalupe Slough;
- Geometry for Alviso Slough was based on 1996 SCVWD and 1998 Cargill surveys;
- Geometry for Guadalupe Slough was based on 1970's SCVWD surveys;
- Geometry for Cargill salt evaporator ponds was based on cumulative data collected by Leslie Salt and Cargill Salt throughout the 1970-1990's timeframe;
- Geometry for Lower Coyote Creek was based on bathymetry shown on USGS Quadrangle mapping;
- Starting water surfaces (brine solution) in Cargill ponds based on 1998 Cargill surveys.

A more detailed description of the dynamic boundary conditions is provided in the following paragraphs:

Dumbarton Tide – The downstream water surface elevation is controlled by tidal elevations in South San Francisco Bay at Dumbarton Bridge. Peak tidal stage and design flood peak discharge were synchronized to coincide at the same time ordinate over the duration of event simulation. Tidal stage and frequency relationships were obtained from the Corps of Engineers (*U.S. Army Corps of Engineers San Francisco District, San Francisco Bay Tidal Stage vs. Frequency Study, October 1984*). A 10-year tide in conjunction with a 1-percent flood event is the basis for design. This is consistent with recommendations from the Corps of Engineers and SCVWD. The following figure shows the design tidal series used in the unsteady modeling of the baylands study area.



Alviso Slough – Two peak discharge events were used to evaluate hydraulic performance of the study area. The existing conditions and design event hydrographs are shown in Figure 4.

The existing (today's) condition was represented by the Corps' LCA[1] hydrograph shape with a 14,000 cfs peak discharge rate. This is the largest discharge that can reach UPRR under present-day Guadalupe River channel capacity conditions upstream of UPRR.

The design event was represented by the Corps' LCA hydrograph with a peak discharge of 17,000 cfs. This is SCVWD's design discharge delivered to UPRR by the proposed Lower Guadalupe River Flood Control Project.

Coyote Creek – The one-percent design hydrograph developed and used by the Corps of Engineers to construct the Coyote Creek Project was also used for the baylands analysis. As was specified for the baylands modeling, the Corps project also used a 10-year tide in conjunction with the Coyote Creek design event. The Coyote Creek design event was lagged by eleven hours (per Dr. Jim Wang, hydrologist, SCVWD) with respect to the Lower Guadalupe River design hydrograph. The Coyote Creek design hydrograph is also shown in Figure 4. Additionally, discharges from the WPCP Treatment Plant just northeast of Alviso were included as flows into Coyote Creek upstream of the UPRR crossing north of Alviso.

Guadalupe Slough – The inflows to Guadalupe Slough are from four primary inflow sources. These sources are San Tomas Aquino Creek, Calabazas Creek, Sunnyvale East Drain and Sunnyvale West Drain. SCVWD provided one-percent event peak discharge rates for these tributary sources. Hydrographs for each tributary were synthesized using the shape of the Guadalupe River hydrograph (upstream of the Los Gatos Creek confluence; i.e. single flood wave event), and scaled by the peak discharge rates to develop the full time-series hydrographs. These hydrographs were not lagged with respect to the Guadalupe River design hydrograph. Figure 5 shows the design hydrographs for these four tributaries.

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[1] The U.S. Army Corps of Engineers and SCVWD Local Cooperation Agreement (LCA) incorporates the adoption of the Corps 1977 Hydrology prescribing the design event hydrograph.

2. Existing- and With-LGR Project Conditions and Analysis Criteria

The following summarizes the SCVWD hydraulic criteria for the baylands reconnaissance-level analysis.

Existing Conditions – The following criteria were applied to represent existing (today's) conditions in the baylands study area:

- 10-Year tide at Dumbarton bridge with the peak tide stage occurring coincident with the Lower Guadalupe River peak discharge at UPRR;
- A Guadalupe River single event, 4-day hydrograph with a peak discharge of 14,000 cfs at UPRR;
- The one-percent event design hydrograph on Coyote Creek, with its peak lagged by 11 hours with respect to the Guadalupe River peak;
- One-percent events on the four tributary inflows to Guadalupe Slough;
- No storm nesting or antecedent conditions which would have created flooding or storage in any of the model's cells prior to the single event simulation;
- Guadalupe Slough geometry based on available 1981 SCVWD HEC-2 modeling (from surveys taken in the 1970's);
- Alviso Slough geometry based on 1996 SCVWD surveys and HEC-2 modeling supplemented with levee profiles collected by Cargill (Thinggaard, P.L.S.) in 1998;
- Alviso Slough overflow location geometry based on 1998 Cargill (Kier & Wright, P.L.S.) surveys;
- Coyote Creek geometry based on 1960± bathymetric mapping available from USGS, NOAA and others;
- Starting water surface elevations in the Cargill salt ponds are normal operating condition brine solution water surface elevations (These operational pond elevations are based on 1998 Cargill [Thinggaard, P.L.S.] surveys);
- The dry portion of Cargill Pond A8 (designated A8D for "Dry") starting elevation is the ground elevation in that particular cell.
- The U.S. Fish & Wildlife Refuge cell (formerly Pond A6) is isolated by recent levee raising activities, and its connection to ponds A5 and A7 is limited by the estimated levee crown elevations.

With-LGR Project Conditions – The following criteria represent the With-LGR Project design conditions in the baylands study area. For various alternatives, geometry and/or model connectivity were modified to depict the operational conditions of each alternative.

- A 10-Year tide at Dumbarton bridge with the peak tide stage occurring coincident with the Lower Guadalupe River peak discharge at UPRR;
- A Guadalupe River single event, 4-day hydrograph with a peak discharge of 17,000 cfs at UPRR;

- The Guadalupe River design event excludes City of San Jose, City of Santa Clara and Caltrans pumping of interior stormwater runoff from the watershed between I-880 downstream to UPRR into the Guadalupe River;
- The one-percent event Corps of Engineers design hydrograph on Coyote Creek, with its peak lagged by 11-12 hours with respect to the Guadalupe River peak;
- One-percent events on the four tributary inflows to Guadalupe Slough;
- Santa Clara County modifications to the Marina in Alviso are completed, raising the parking lot and perimeter levees to prohibit flooding into the Town of Alviso;
- An improved overflow zone (modeled as a weir) at the same location near Cargill pond A8 across from Alviso (the purpose is to remove any chance of this location eroding or being scoured out as a result of the higher overtopping flows generated by the design event);
- No storm nesting or antecedent conditions which would have created flooding or storage in any of the model's cells prior to the single event simulation;
- Unless specifically modified for project conditions, antecedent or geometric conditions are identical to those specified for existing conditions.

3. Past Baylands Studies Performed for SCVWD

Beginning in 1998, several hydraulic and environmental reconnaissance studies have been performed which support the development of baseline and possible LGR project mitigation features. Key reports and Memos include:

- *Sediment Transport and Water Quality Modeling of the Knapp Unit of the Don Edwards San Francisco Bay National Wildlife Refuge Complex*, Department of Civil and Environmental Engineering, University of California, Davis, California, February 1998.
- *Preliminary Geomorphic and Hydrodynamic Assessment of The Guadalupe River, Alviso Slough, Guadalupe Slough and Its Tributaries, and the Cargill Salt Pond System,* Northwest Hydraulic Consultants, Inc., June 1998.
- *Calculation of Effective Suspended Solids Concentrations in Alviso Slough, California,* R.B. Krone & Associates, June 1998.
- *Calculation of Effective Suspended Solids Concentrations in Guadalupe Slough, California,* R.B. Krone & Associates, November 1998.
- *Draft Reconnaissance Report – Engineering and Environmental Reconnaissance Studies of the River Reach from UPRR to the Bay*, Northwest Hydraulic Consultants, Inc., June 2000.
- *Draft Engineer's Report, Lower Guadalupe River Planning Study*, CH2M Hill, August 2001.
- *Draft Environmental Impact Report, Lower Guadalupe River Planning Study*, Jones & Stokes, Inc., August 2001.
- Twelve SCVWD supplemental baylands analyses assignments (Oct. 2000 through Dec. 2001) subsequent to the completion of the Draft Reconnaissance Report.
- Responses to questions raised by Schaff and Wheeler in letter of 10-15-01.

Summary Results of Alternatives Analyses – Several alternative scenarios have been evaluated to assess flooding impacts in the baylands. Some of these scenarios include: existing conditions, a variety of modifications along Alviso Slough, the dredging of an auxiliary waterway from Alviso to the bay (the "Bob Gross alternative"), managing flood volumes within Cargill ponds A5-A8, returning A5-A8 back into salt marsh habitat, isolating and maximizing Cargill pond A8 storage, and sizing of the Pond A8 improved overflow for no-net increase to downstream conditions (water surface profiles) in Alviso Slough. The results exclude long-term impacts associated with sea-level rise, possible future subsidence and levee settlement in the region. All reconnaissance results are provisional, and are not suitable for design purposes.

Existing Conditions – Under present-day conditions, the analyses indicate that inundation to Cargill ponds A5-A8 could range from ~6 feet to ~8 feet on top of present operating brine solution water surfaces. Floodwaters spill into ponds A5-A8 and A3E from both Guadalupe Slough and Alviso Slough during high flows. The following table (at the right) shows the estimated impacts in terms of depth of flooding above the pre-storm brine surface elevation in ponds A3E, A5, A7, and A8W (A8D starting elevation is the dry pond's invert). Recent improvements by the USFWS Refuge have raised the levee between A5/A7 and A6 to reduce the chance of overflows from A5 and/or A7 into A6.

Existing Conditions Inundation Impacts
(for a 14,000 cfs LGR event)

Flooding by Location	Depth (ft)
Cargill Pond A5	5.8
FWS Refuge (A6)	-
Cargill Pond A7	5.8
Cargill Pond A8W (Wet)	8.1
Cargill Pond A8D (Dry)	5.8
Cargill Pond A11	-
Cargill Pond A12	2.1
Cargill Pond A13	2.5
Cargill Pond A15	1.4
Cargill Pond A16	-
Cargill Pond A17	3.3
Cargill Pond A3-East	0.1
Cargill Pond A3-West	-

The primary source of Alviso Slough flood water entering the ponds is at the low spot in the Cargill A8 pond levee across from Alviso. The flow split during the peak discharge of 14,000 cfs entering Alviso Slough is approximately 9,700 cfs continuing downstream and out to the bay, while the remaining 4,300 cfs spills into ponds A5-A8. The duration of spill is around 30± hours, and results in approximately 9,950 acre-feet of spill into ponds A5, A7 and A8.

Design Conditions – When the Lower Guadalupe River (LGR) flood event is increased to the 17,000 cfs peak design event, (and all other boundary conditions remain the same as under existing conditions) and with Pond A8 overflow location and Marina improvements only downstream of UPRR, the inundation depths increase by approximately ¾ to 1 foot, to a range of 6-½ feet to 9 feet above pre-storm brine surface elevations. The table at the right shows the estimated inundation impacts to the ponds for

Design Event Inundation Impacts
(for a 17,000 cfs LGR event)

Flooding by Location	Depth (ft)
Cargill Pond A5	6.7
FWS Refuge (A6)	-
Cargill Pond A7	6.8
Cargill Pond A8W (Wet)	9.1
Cargill Pond A8D (Dry)	6.7
Cargill Pond A11	-
Cargill Pond A12	1.8
Cargill Pond A13	2.2
Cargill Pond A15	1.4
Cargill Pond A16	-
Cargill Pond A17	3.3
Cargill Pond A3-East	0.1
Cargill Pond A3-West	-

the design event without any actions to reduce or diminish the impacts.

The primary source of Alviso Slough floodwater entering the ponds is outflow at the same low spot across from Alviso. The flow split during the peak discharge of 17,000 cfs (with Pond A8 overflow improvements only in the baylands) entering Alviso Slough is approximately 10,900 cfs continuing downstream and out to the bay, while the remaining 6,100 cfs spills into ponds A5-A8. The duration of spill is about 30± hours, and results in approximately 10,950 acre-feet of spill into ponds A5, A7 and A8.

Dredging Alviso Slough – Dredging Alviso Slough to increase the hydraulic capacity was assessed during the Reconnaissance Study, but was dismissed because this option provided nominal hydraulic benefits (because the entire slough is tidally controlled), would induce significant adverse environmental impacts to habitat and sensitive species along the slough corridor, and would require significant and costly annual maintenance to remove sediment. Excluding sediment transport processes depositing terrestrial materials from the Lower Guadalupe River, marsh accretion processes will deposit between 0.25 to 0.5 feet of material into the dredged channel annually.

New Channel Construction – The construction of a new navigational channel from Alviso to the bay was presented in Chapter 4 of the Draft Engineer's Report. This alternative was dismissed since it provided nominal hydraulic benefits, had a high capital cost (~$65 million plus mitigation and right-of-way costs), and required substantial and costly maintenance. For more information, refer to page 4-24 in the Draft Engineer's Report.

Marsh Restoration – This scenario raised the invert surfaces of ponds A5-A8 up to mean higher high water, and opened the entire northwest levee boundary of A6 to the bay. This area was modeled as a routing reach for Alviso Slough and Guadalupe Slough overflows. The A8 overflow location was improved (similar to other alternatives) to protect it from erosion or scour during overtopping events. None of the Alviso or Guadalupe Slough levees were removed for this analysis, and the mechanics of restoring the marsh plain were not analyzed. Results of this scenario indicated a rise in the starting water surface elevation for the LGR Project by approximately 1 to 1-½ feet (near Gold Street). The alternative was dismissed because land acquisition costs would be excessive, and the marsh accretion processes would take anywhere from 30 to 50 years to successfully re-establish a salt marsh plain at mean-higher-high water. NHC recommended that this alternative be considered and refined further as a potential ultimate marsh reclamation alternative some time in the future.

Alviso Slough Modifications – In order to improve conveyance capacity downstream of UPRR, modifications to the Alviso Slough levees and to the A8 overflow (weir) location were assessed. These modifications considered raising the levee and overflow weir elevations to reduce overflow into the salt ponds. Specifically, modifications to Alviso Slough levees and/or overflow included:

- Raising the levees to carry the entire design discharge to the bay;
- Raising the overflow crest elevation by one foot to gain some flood protection to Cargill ponds;
- Raising the overflow crest elevation by three feet to gain flood protection to Cargill ponds.

- Refinements to the overflow weir were recently made (February, 02) to maintain existing conditions water surface elevations along Alviso Slough during the design event.

Maximum water surface profiles for these scenarios are shown in Figure 6. The figure shows that by raising both Alviso Slough levees to prohibit any overtopping between UPRR and the bay, the water surface is raised as much as 3+ feet above the existing conditions profile. This would impact the LGR Project upstream from Alviso since the starting water surface for that project would be increased by 2.5± feet. Raising the overflow crest elevation near A8 by either 1- or 3-feet raises the water surface profile between UPRR and the overflow by about 1 foot, with a diminishing increase as you progress downstream to the bay. Significant increases in Alviso Slough levee heights may not be feasible since the levees sit on soft bay muds, and their structural integrity as non-engineered facilities is unknown. Any levee improvements would require a geotechnical investigation to determine the integrity of the levees and their underlying, subsurface conditions. The removal and replacement with engineered levees would be extremely expensive, and are likely to result in significant impacts to sensitive environmental areas along the slough corridor. Reconstructed levees would require designs that comply with recent seismic stability and wave erosion regulations.

In order to eliminate project-induced impacts downstream of the overflow location, the weir was sized to reduce the with-project conditions (Q_{LGR}=17,000 cfs) to those similar to pre-project (existing; Q_{LGR}=14,000 cfs) conditions. The lowest crest elevation was not changed, but the length of the weir was adjusted until the design conditions downstream water surface profile was comparable to the pre-project conditions, resulting in a multi-crested weir approximately 1,000 feet long. This results in an additional 2 feet of water into ponds A5, A7, and A8.

These analyses assumed that no scour or levee failures along Alviso Slough would occur, even if overtopped, for the entire duration of either an existing conditions or with-LGR design storm event. However, if overtopping were to result in a failure of Alviso Slough's right (east) levee (facing downstream), preliminary results indicate a high probability of significant flooding to Federal, private and public lands east of Alviso Slough.

Cargill Pond Flood Attenuation and Storage – The Cargill ponds A5-A8 and the U.S. Fish & Wildlife Refuge (formerly A6) act as flood storage cells during large events. As A8W fills, excess floodwaters start to cascade into A8D, then A7 and A5, and given enough time and a large enough storm event, flow can enter into A6. If the interior levees on one or more of these cells are raised to restrict or reduce overflow from adjoining cells (i.e. – from A8W into A5 or A7), the remaining cells without levee improvements end up storing more water, resulting in higher water surface elevations and greater duration of ponding in those cells.

Flood Prone Area or Cell:	Design Conditions Inundation Depth (ft) (Raised A6 Levees)	Design Conditions Inundation Depth (ft) with Raised Interior A5, A6 and A7 Levees
Cargill A5	6.7	4.6
USFWS Refuge-A6	0.0	0.0
Cargill A7	6.8	4.6
Cargill A8W	9.1	12.7
Cargill A8D	6.7	10.3

If the Pond A8 interior levees are raised to reduce spill into Ponds A5 and A7 from A8, more flood flows remain in Alviso Slough than if flows are allowed to fill A5 and A7. NHC's assumption was that interior levees would be raised to elevations 3 feet below the tops of the main slough levees. Spills could still overtop the levees at low spots downstream of Alviso, spilling into ponds A5 (through A7), A7. Since the raised A8 levee is still lower than adjoining Alviso or Guadalupe Slough levees (to prevent induced failure of either slough's levees), ponds A5 and A7 are also still susceptible to spills from Pond A8W, as well as overtopping spills at low spots along the Guadalupe Slough and the Alviso Slough levees downstream of Alviso. Figure 7 shows the fluctuations in pond A5-A8 water surface elevations during the design event. The table above shows the changes in inundation depth above pre-flood brine solution elevations for ponds A5, A7, A8W and A8D.

Further simulations were performed to develop a relationship between Alviso Slough peak flows versus the elevation of the interior levees at A8W and A8D to maximize storage potential if the interior A8 levees are raised to reduce the flood threat to A5 and A7. A steady-state tidal boundary condition as well as a dynamic tidal boundary condition was tested. As presented during the discussions with Cargill on 10 December 2001, maximizing the height of the A8D-A8W levee and the A8W-A5&A7 levee would provide improved flood protection to A5 and A7 for Alviso Slough events up to about a 11,300-cfs peak discharge event for a dynamic downstream boundary condition, and up to about a 10,500-cfs peak discharge event for a static downstream boundary condition. Figure 8 shows the results of this sensitivity analysis.

Gravity Outfall for Ponds A5-A8 – This analysis looked at installing uni-directional gravity drains to reduce the duration of flood storage in Ponds A5 through A8 following large flood events. The initial analysis approximated inundation durations for the impacted ponds. If no post-flood event drainage systems (gravity drains, pumps, etc.) are installed, then it might take anywhere from 20+days to 2± years (depending on the pond and depth of inundation) to remove the floodwaters by evaporation only. These estimates account for precipitation during the wet seasons within the evaporation period.

The results of installing uni-directional, 8-foot diameter gravity drains into A5, A7, A8W and A8D (one drain per cell) dropped the interior water surfaces down somewhat. The efficiency of gravity drains is reduced over time as the elevation of the ponds approach mean tide and lower tide elevations. The following table shows durations to effectively drain the ponds A5-A8 entirely by passive means (i.e. – gravity drainage only).

Pond A5-A8 Drawdown Duration by Gravity Drainage Only

Storage Cell	*Drawdown Duration (months*)*
Cargill Pond A5	~3.7
Cargill Pond A7	~4.9
Cargill Pond A8W	~6.8 – 9**
Cargill Pond A8D	~4.4
USFWS Refuge (A6; if flooded)	~2.3

* Duration estimates include the initial single 4-day storm event.

** This high-end duration is based on using an average drawdown curve slope from Ponds A5, A7 and A8D to predict duration to intercept pre-storm starting pond elevation.

This length of time to both drain the ponds and restore operability (debris removal and cleanup) for brine solution production could be close to a year. Thus, it was recommended that supplemental pumping in addition to gravity drains might be necessary to remove the remaining floodwaters from A5-A8.

Pump-assisted Gravity Outfall for Ponds A5-A8 – This analysis looked at installing pumps to supplement the uni-directional gravity drains for reducing the duration of flood storage in Ponds A5 through A8, and completely evacuating the flood volumes from these interior storage cells. Five pumps of a particular size were specified to drain the ponds. (The analysis did not look at the impacts associated with diluting the brine solution which would result in added evaporation duration times to restore the salinity of the waters remaining in the ponds after the pumping.) Figure 9 shows the results of the inundation duration assessment for a combination of gravity drains and pumping using five (5) 25-cfs capacity pumps, and using five (5) 100-cfs capacity pumps. Long-term duration assessment accounts for precipitation over the wet season, and evaporation processes during the dry portions of the period of assessment. The addition of pumps in each cell can reduce drawdown durations significantly.

4. Additional Options Considered and Dismissed.

The following options were considered early in the Lower Guadalupe River project. The District, for various reasons (cost; constructability; operability; etc.), determined that these alternatives were not implementable. Therefore, no further consideration was given to these alternatives.

- Upstream floodwater storage
- Change in existing reservoir operations
- Watershed transfer
- Offstream storage

Previous analyses by the SCVWD and COE dismissed upstream storage or reservoir reoperation as viable options.

A flood flow bypass channel (or pipeline) concept to Lower Coyote Creek was given consideration, but screened out due to prohibitive costs to construct such a facility. No viable routes for even a 5,000-cfs capacity facility could be delineated. Real estate acquisition costs alone were considered extreme. The concept was also dismissed due to potential operational limitations. Transfers of Guadalupe River flows to lower Coyote Creek would require close scrutiny to ensure that the transfer would not instigate backwater (and associated induced impacts) conditions resulting in an adverse impact to the Coyote Creek Flood Control Project. Transfers of additional flood flows to Coyote Creek could worsen the potential flood threat on Cargill lands and the Town of Alviso from present-day Coyote Creek conditions.

An additional baylands alternative of bypassing some of the flows from Guadalupe River to Guadalupe Slough was considered at a conceptual level, but was dismissed due to physical and environmental limitations.

5. Refinement to the Dimensions of the Proposed Alviso Weir (refined 01-14-02)

Following discussions with District staff, NHC performed additional analyses of the proposed Alviso Slough Weir dimensions in order to maintain existing conditions water surface elevations along Alviso Slough during the design event. Following is a summary of the results provided to the District on January 14, 2002.

Water surface profile sensitivity analyses were performed to determine weir dimensions necessary to maintain existing water surface profile conditions along Alviso Slough during the design event. It was determined that a multi-crested weir, 1000 feet in length is required.

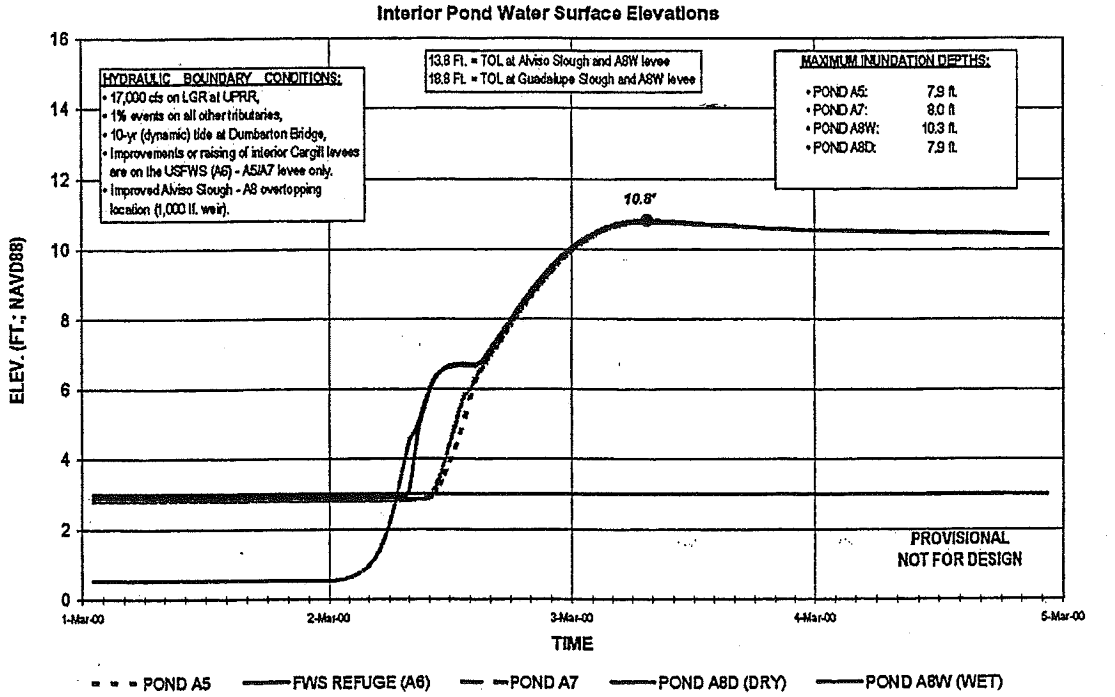
The refined overflow weir (1000 feet) was incorporated into the UNET model and rerun for the following two scenarios:

1. 17k cfs from LGR, improved (1000-foot) weir in-place, no change in height of the interior levees A8W-A5, A8W-A7, or A8W-A8D. See Figure 10. (See attached file: FIGURE 10.PDF)
2. 17k cfs from LGR, improved weir in-place, maximized heights of interior levees between A8W-A5, A8W-A7, and A8W-A8D. See Figure 11. (See attached file: FIGURE 11.PDF)

Discussion of results presented in these two figures:

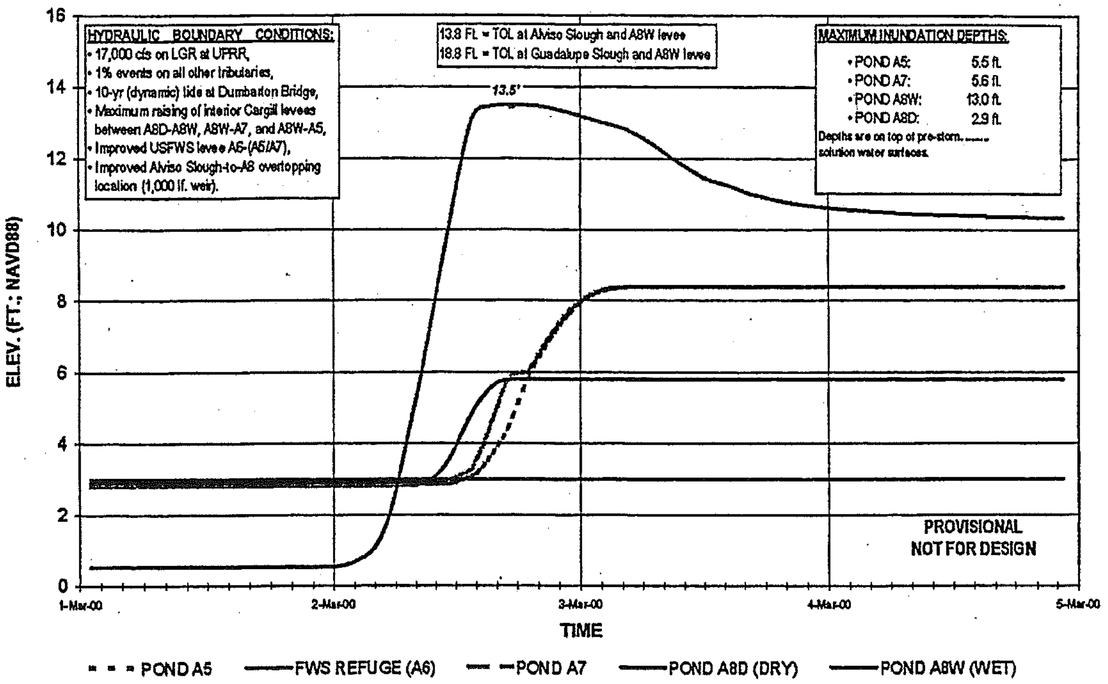
1. In Fig10, the interior ponds of A5, A7, A8W and A8D all reach a common, commingled flood elevation of about 10.8 feet. This is because there is cascading floodflows from A8W into the other cells once existing interior levees are overtopped. In Fig11, the highest possible interior levee A8W-A8D, built to match the crown of either Guadalupe or Alviso Slough levees as directed by the District, is about 13.8 feet. Nhc and SCVWD also agreed that the interior levee between A8W-A5/A7 would be maximized at 1 foot less than the A8W-A8D levee, or 12.8 feet. Model results indicates that for these conditions, A8W will fill to a maximum elevation of 13.5 feet, and some cascading into A5 and A7 will have occurred. Although A5 and A7 get flooded, they are flooded to a lesser depth under this scenario. The flooding in A8D (for this scenario) is associated with Guadalupe Slough overflows, not the cascading flow from A8W since the levee is raised to a height greater than the maximum A8W pool. Unfortunately, A8W can't reach that flood pool elevation

depicted in Pond A8W. There are significant stretches of the west Alviso Slough levee crown between the weir and that A8W-Alviso Slough levee intersection point downstream that are below the 13.5-foot peak elevation. There are insufficient top-of-levee measurements to accurately assess the complete filling of a large pond (like A8W). Several known low spots in the levee profile were coded to identify when Alviso Slough leaks out into the ponds, but NO pond was coded up to identify all of its potential leaks due to the lack of reliable information. This idea of maximizing the storage in Pond A8W to provide extra benefits to A5 and A7 presumes that all levees containing storage remain intact. Additional geotechnical analyses and wave scour/overtopping analyses are necessary to verify this assumption. If maximizing the pool stage in A8W initiates a levee failure back into Alviso Slough, localized scour and energy concentrated against the east levee bank could induce its failure. (Refer to earlier memorandum explaining the potential ramifications of a levee failure to the east of Alviso Slough). During this type of failure, either/both interior salt pond areas (east and west of Alviso Slough) could be opened up to tidal action. This means that you can't drain the interior lands until failed openings are patched, then pumping of the flooded interior areas can commence.



LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT

FIGURE 10
INUNDATION DEPTHS TO CARGILL PONDS A5-A8 AND USFWS REFUGE (A6)
SUPPLEMENTAL BAYLANDS HYDRAULIC ASSESSMENT
JANUARY 2002



Interior Pond Water Surface Elevations with Raised Interior Levees

LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT

FIGURE 11
INUNDATION DEPTHS TO CARGILL PONDS A5-A8 AND USFWS REFUGE (A6)
SUPPLEMENTAL BAYLANDS HYDRAULIC ASSESSMENT
JANUARY 2002

6. Effects To Baylands from Adding Interior Drainage Flows to Corps' Design Hydrograph (results as of 02-26-02)

Purpose

The purpose of the on-going Baylands planning study is to assess and compare existing and with-proposed- LGR project conditions, including (a) peak water surface profiles along Alviso and Guadalupe Sloughs, (b) the volume and depths of excess water that drains into the salt ponds west of Alviso Slough during the design event, and (c) develop conceptual Baylands components (mitigation improvements) to mitigate for potential LGR project induced impacts. Previous analyses of the LGR Project and the Baylands did not include interior drainage as part of the design event hydrograph. Therefore, the purpose of the specific analysis reported herein is to identify hydraulic impacts to the Baylands (e.g., changes to water surface elevation along Alviso Slough and depths of ponding n the salt ponds) associated with the inclusion of interior drainage allowed to enter the Lower Guadalupe River downstream of I-880 during the design event.

Methods

Preceding discussions describe the methods used to estimate flow contributions from the most significant pumped or gravity drain inflows found downstream of I-880. Modeling methods used to assess the hydrodynamics of the Baylands are documented in previous documents provided by CH2MHill and the District.

Summary of Findings

Three different hydrologic scenarios are analyzed to identify possible hydraulic impacts to the Baylands resulting from project improvements to the Lower Guadalupe River upstream of the UPRR Bridge. These scenarios include:

1. *Present-day, Pre-project* (PDPP): The present-day, pre-project scenario (PDPP) assumes that the present LGR channel capacity upstream of UPRR can only deliver a 14,000-cfs peak discharge hydrograph to Alviso Slough,
2. *COE Design Hydrograph with No Interior Drainage* (COE-NoID): This scenario uses the COE design hydrograph with No interior drainage entering the LGR downstream of I-880 (COE-NoID). This scenario delivers a 17,000-cfs peak discharge hydrograph to Alviso Slough that excludes all interior drainage (pumping or gravity drains) to the river downstream of I-880.
3. *COE Design Hydrograph With Interior Drainage* (COE-WithID): This scenario combines the COE design hydrograph with inflows from fourteen interior drainage locations discussed above. The COE-WithID scenario has an increased peak flow of 18,350-cfs and a greater event volume than the COE-NoID scenario.

Following is a summary of key results from this study of the effects of these three scenarios on the Baylands:

Table 5 summarizes the inundation depths to Cargill Ponds A5, A7 and A8, and the USFWS Refuge (A6) for the three (3) different scenarios described above. Table 6 summarizes the approximate volumes and hydraulic conditions across the engineered overflow weir for the three scenarios.

- Table 5 summarizes changes to ponding depths results from scenarios 1, 2 and 3. Including interior drainage in the design hydrograph (scenario 3, COE-WithID) increases the depth of inundation to Cargill Salt Ponds A5, A7, and A8 by 0.2 – 0.3 feet when compared to scenario 2, COE-NoID.
- Depths of inundation in Ponds A5, A7 and A8 associated with scenario 2 (COE-NoID) range from 3.0 – 11.1 feet;
- Inclusion of interior drainage (scenario 3, COE-WithID) causes the U.S. Fish and Wildlife (USFWS) Don Edwards Refuge property (formerly Pond A6) to become inundated to a depth of approximately 1.1 feet. The USFWS Refuge does not get flooded for either scenarios 1 or 2.
- The estimated total flood storage potential of the Cargill Ponds A5, A7 and A8 above their present dry ground or existing salt pond elevations is approximately 13,050 Acre-Feet (AF). Under present-day conditions (Scenario 1, PDPP), approximately 8,800 AF spill into Ponds A5, A7 and A8. Under scenario 2 (COE-NoID) , approximately 11,680 AF spill into Ponds A5, A7 and A8; no spills enter pond A6. Approximately 13,730 AF spill into Ponds A5, A7, A8 and Pond A6 (the USFWS Refuge) under scenario 3, COE-WithID, thus exceeding the present ponding capacity of ponds A5, A7 and A8 to contain the increased spill volume. The excess flood waters drain into Pond A6 with some draining back over the levees back into Alviso and Guadalupe Sloughs. Table 6 and its figure summarize the changes in volume entering the ponds for the three scenarios.;
- Approximately 4,300 acre-feet of runoff volume is added to the COE design hydrograph if interior drainage effects are added downstream of I-880. Approximately 2,050 acre-feet (roughly 47%) of this added volume spills into Cargill Ponds A5, A6, A7 and A8 resulting in increased ponding depths in A5, A7 and A8 the addition of approximately 1.1 feet of ponding in A6. Tables 5 and 6 summarize and compare the results for all three scenarios.
- Under present conditions there is no "engineered weir" on the west levee adjacent to Pond A8, only a low section of levee that has functioned in the past as a default weir allowing a portion of the high river flows passing Alviso to spill to the west over the low section in the levee. One of the proposed project mitigation components is an engineer weir to replace the default low section. Preliminary analyses show that a 1,000 foot-long, multi-crested weir is required to maintain pre-LGR Project water surface profiles along Alviso Slough downstream of the County Marina Construction of such a weir may also lower the project design water surface profile near Gold Street Bridge and UPRR bridge by as much as 0.5 feet. Further detailed design studies are required to verify the performance of this concept plan. Figure 17 shows the Alviso Slough water surface profile for both present-day pre-project conditions, and for the LGR-Project with stormwater runoff included (scenario 3, COE-WithID). Note that there is no freeboard allowance along Alviso Slough at the present time. The question marks in figure 17

indicate that we have made a "glass wall assumption" that the adjacent low sections of the west levee will be raised to isolate the 1000 foot weir .

Baylands Hydraulic Analysis

A UNET model developed by NHC is used to evaluate the unsteady hydraulic characteristics of the 25 square mile baylands study area. This model allows for analysis of the effects of unsteady flow conditions associated with various phased inflow hydrographs, a downstream tidal boundary conditions, and exchange of excess floodwaters into or out of storage areas (predominantly Cargill salt evaporation ponds). Following is a summary of the hydraulic boundary conditions used for the baylands analyses, and a brief listing of key exclusions or limitations of these analyses.

Boundary Conditions – The following list summarizes the boundary conditions used for: (i) existing conditions analyses, (ii) with-LGR Project conditions excluding the interior drainage flows downstream of I-880, and (iii) with-LGR Project conditions including interior drainage flows downstream of I-880.

Common Assumptions and Boundary Conditions Used for all Scenarios

A. A four-day duration event is used to analyze the baylands hydraulics. This allows for simulation of the Corps' two-day Guadalupe River hydrograph as well as the Corps' four-day Coyote Creek hydrograph including a lag in the Coyote Creek hydrograph;

B. Hydrographs for the Coyote Creek and Guadalupe Slough tributaries (San Tomas, Calabazas, Sunnyvale East, Sunnyvale West;) are shown in Figures 18 and 19.

C. The Coyote Creek one-percent event hydrograph is based on the Corps of Engineers' Coyote Creek Project design hydrograph, and is lagged by eleven (11) hours with respect to the peak of the LGR hydrograph;

D. The tide boundary condition at Dumbarton Bridge (the downstream boundary of the baylands UNET model) is a 10-year tide (see Figure 20). The 10-year tide shape is based on the shape of the historical tide that occurred during the March 1995 flood event. The 10-year tide peak is prescribed by the U.S. Army Corps of Engineers, and is produced by amplifying all hourly tide ordinates above mean tide level by the ratio between the 10-year Corps tide estimate and the peak tide produced during the March 1995 storm tide. Tide ordinates below mean tide level were not modified. The 10-year tide series was then translated in time to synchronize the peak tide stage to within an hour of the LGR peak flow rate entering Alviso Slough. The result is a design tide which includes conditions associated with high river discharge conditions entering the bay, low pressure in the south bay, and storm surge or setup in the south bay expected during a major regional storm event.

E. Assume no storm nesting and that there are no antecedent ponding effects in the ponds west of Alviso Slough when the design event occurs (e.g., we assume all of the available storage volume is available when the design event occurs).

F. If river or ponding stages exceed the top of levee elevations in the model, we assume a "glass wall" condition exists and do not account for spills over the levees if they are lower than computed water surface elevations. We do account for spills and levee overtopping at a few key locations were survey data indicate low spots in the levees.

i. Present-day (Existing) Conditions Analysis

G. The maximum LGR event discharge entering Alviso Slough is 14,000 cfs, limited by upstream bankfull channel capacity (see Figure 21);

H. No engineered improvements in the baylands study area (i.e. – spillage into Cargill Ponds A5, A7 and A8 associated with present-day levee profiles with low spots (based on readily available topographic mapping and past field surveys);

I. The interior levee that separates the USFWS Refuge from Cargill Ponds A5 and A7 was estimated at a height of 11.0 feet (NAVD88). The actual height of this levee as a result of recent improvements is unknown;

ii. LGR Project Conditions Analysis Excluding Interior Drainage

J. The LGR design hydrograph with a peak discharge of 17,000 cfs entering Alviso Slough (see Figure 21);

K. A 1, 000-foot long engineered weir on the west levee across from Alviso which allows controlled overflow from Alviso Slough into Cargill Pond A8;

L. Improvements to the County Marina parking lot and levees to exclude high stages in Alviso Slough from spilling through the marina into Alviso;

M. The interior levee between A8D (dry portion of A8) and A8W (active salt pond evaporator) is raised to a height of 11.0 feet;

N. The interior levee between A8 and A5-A7 is raised to a height of 10.0 feet;

Boundary conditions **A.**, **B.**, **C.**, **D.**, **E.**, **F.** and **I.** above are included in this analysis.

iii. LGR Project Conditions Analysis Including Interior Drainage Flows Downstream of I-880

O. The LGR design hydrograph with a peak discharge of about 18,350 cfs entering Alviso Slough (see Figure 21). Boundary conditions **A.**, **B.**, **C.**, **D.**, **E.**, **F.**, **I.**, **J.**, **K.**, **L.**, **M.** and **N.** above are included in this analysis.

Key Assumptions and Limitations of Baylands Hydraulic Analysis

The results contained herein are for planning purposes only and are not suitable for design. The following is a summary of key assumptions and limitations of the present baylands analyses:

- All modeling scenarios assume that all slough and interior levees remain intact during the entire storm duration and afterwards, even if the levees are overtopped. Prior to final selection of the preferred baylands components and their design-level hydraulic analyses, the structural integrity of these non-engineered levees will be determined.
- Numerous "leaks" above 10+ foot elevation on the Alviso Slough and A8W levee are likely, but are not presently included in the model. Only the lowest known locations based on existing available surveys are coded as weir locations in the UNET model;
- Guadalupe Slough contributes some flooding to A5, (maybe A7) and A8D. More up-to-date top of levee profile data are required to more accurately compute the potential contributions from the Guadalupe Slough
- The occurrence of future subsidence or levee settlement is not included in the analysis;

- The long-term sea level is assumed to remain constant and the provision for on-going sea level rise in the south bay is not accounted for;

- All of the dimensions, sizes, heights, etc. used to depict physical conditions in the models is from existing, readily available data. Some of these data are quite old and require updating;
- No analyses have been performed to evaluate the system's performance for during events greater than the design event ;
- The effects of wind set up and waves have not been included in any of the analyses. Wind set up and waves can affect the performance of the engineered weir and could contribute to levee erosion and possible levee overtopping during significant storm events;
- The estimated dimensions of the engineered overflow weir is based on calm conditions in the interior (A5-A8) ponds. No account for wave setup induced tailwater effects to the overflow weir capacity have been included;

Figure 17
Alviso Slough Water Surface Profile Comparison Existing Conditions vs. LGR Project Including Interior Drainage

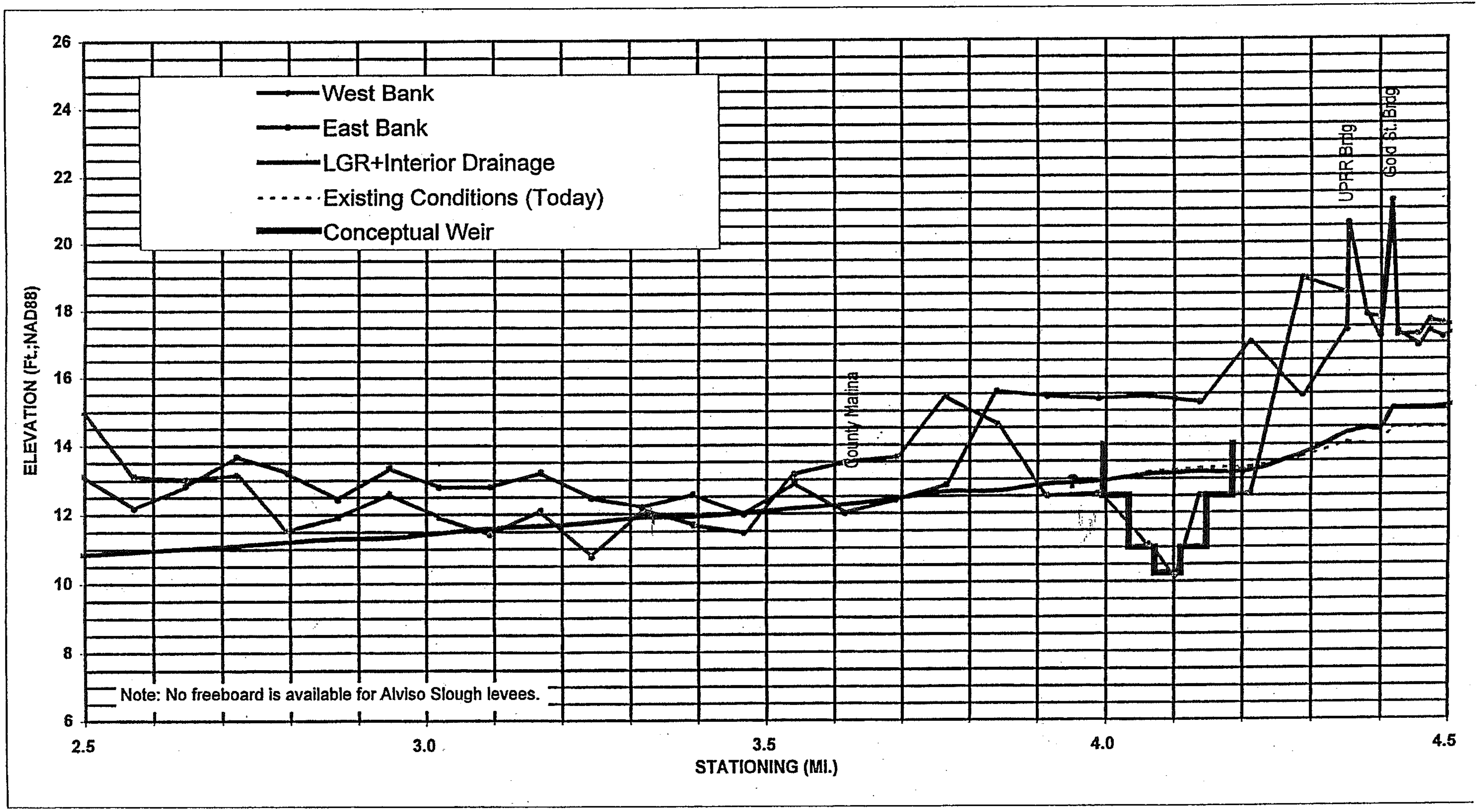


Table 5
Inundation Depths in Cargill Ponds A5-A8 and USFWS Refuge
Comparison of Existing vs. With-LGR Project Conditions

		EXISTING CONDITIONS SCENARIO 1 (Qp = 14,000 CFS)		LGR PROJECT AND NO INTERIOR DRAINAGE SCENARIO 2 (Qp = 17,000 CFS)		LGR PROJECT WITH INTERIOR DRAINAGE SCENARIO 3 (Qp = 18,350 CFS)	
	Pre-storm Pond or Ground$^{(1)}$ Elevation	Post 4-day Storm:		Post 4-day Storm:		Post 4-day Storm:	
Location		Water Surface Elevation	Depth of Inundation	Water Surface Elevation	Depth of Inundation	Water Surface Elevation	Depth of Inundation
Cargill Pond A5	2.9'	8.9'	6.1'	11.0'	8.2'	11.3'	8.4'
USFWS Refuge (A6)	3.0'	3.0'	-	3.0'	-	4.1'	1.1'
Cargill Pond A7	2.8'	8.9'	6.1'	11.0'	8.2'	11.3'	8.5'
Cargill Pond A8(Dry)$^{(1)}$	2.9'	8.9'	6.0'	5.9'	3.0'	6.9'	4.0'
Cargill Pond A8(Wet)	0.5'	8.9'	8.4'	11.1'	10.6'	11.5'	10.9'

Note: (1) - Pond is dry prior to storm-induced flooding.

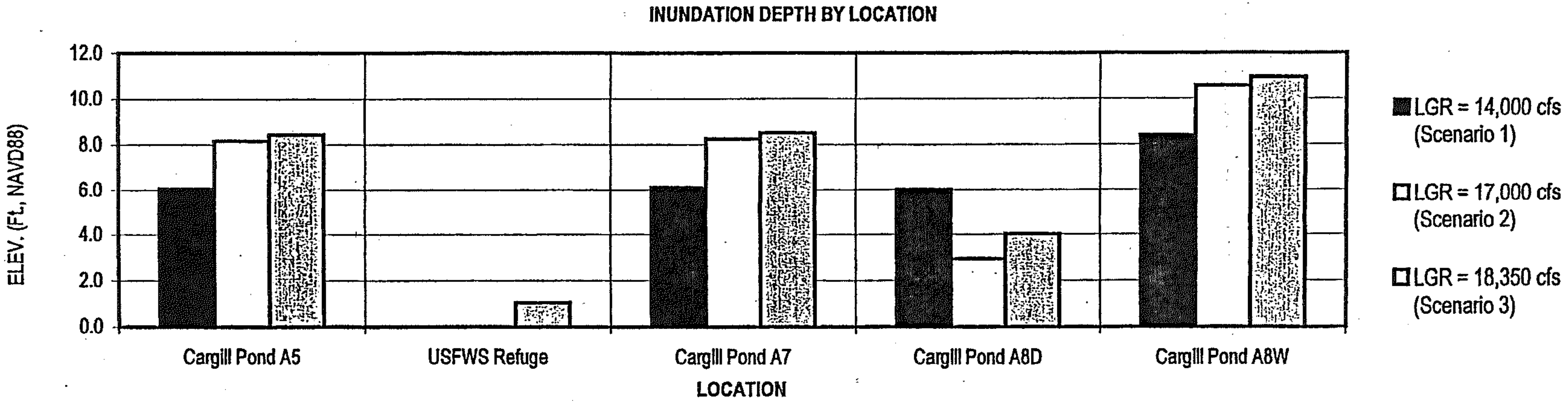
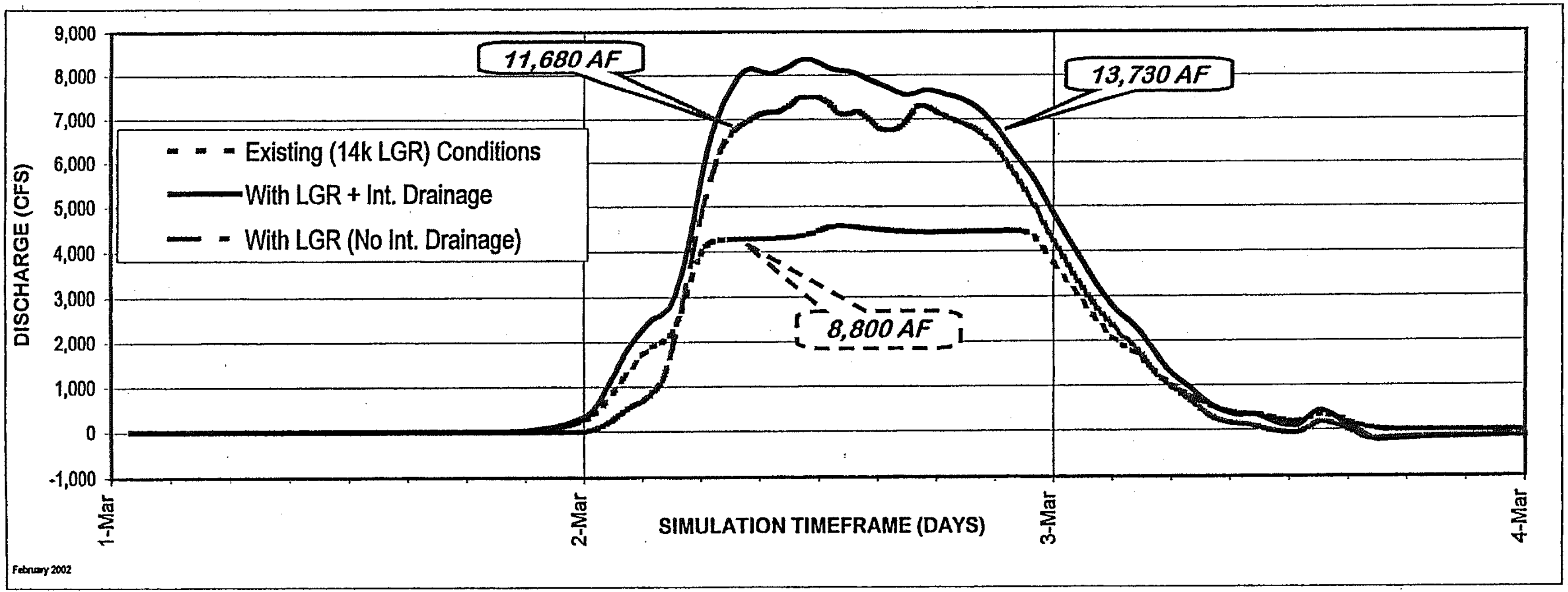


Table 6
Comparison of Overflow Volumes into Ponds
For the Three Scenarios

	EXISTING CONDITIONS SCENARIO 1 (Qp = 14,000 CFS)		LGR PROJECT ONLY SCENARIO 2 (Qp = 17,000 CFS)		LGR + INT. DRAINAGE SCENARIO 3 (Qp = 18,350 CFS)	
Overflow Effects at A8W:	Peak Flowrate	Net(2)(3) Volume	Peak Flowrate	Net(2)(3) Volume	Peak Flowrate	Net(2)(3) Volume
Existing Levee Low Spot:	4,600 cfs	8,800 AF	-	-	-	-
Engineered 1,000-lf Weir:	-	-	7,500 cfs	11,680 AF	8,400 cfs	13,730 AF

(2) - Includes volume of floodwater spilling back across weir from A8W into Alviso Slough after storm peak has passed.

(3) – Present estimated total storage capacity of Ponds A5, A7 and A8 below elevation 11.0 feet is around 13,050 acre-feet.



February 2002

Figure 18
One-percent Design Hydrograph for Coyote Creek

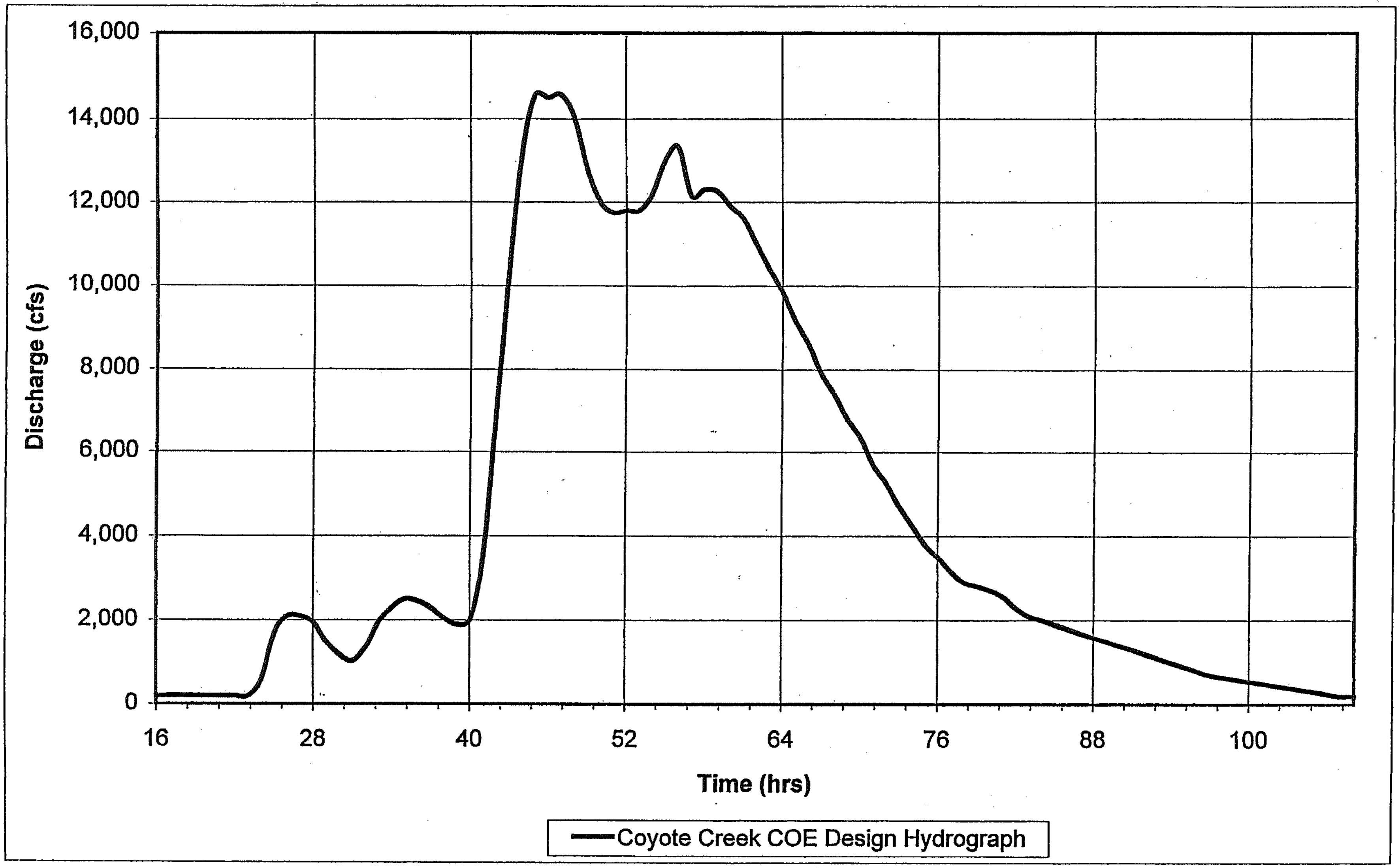


Figure 19
One-percent Design Hydrographs for Guadalupe Slough Tributaries

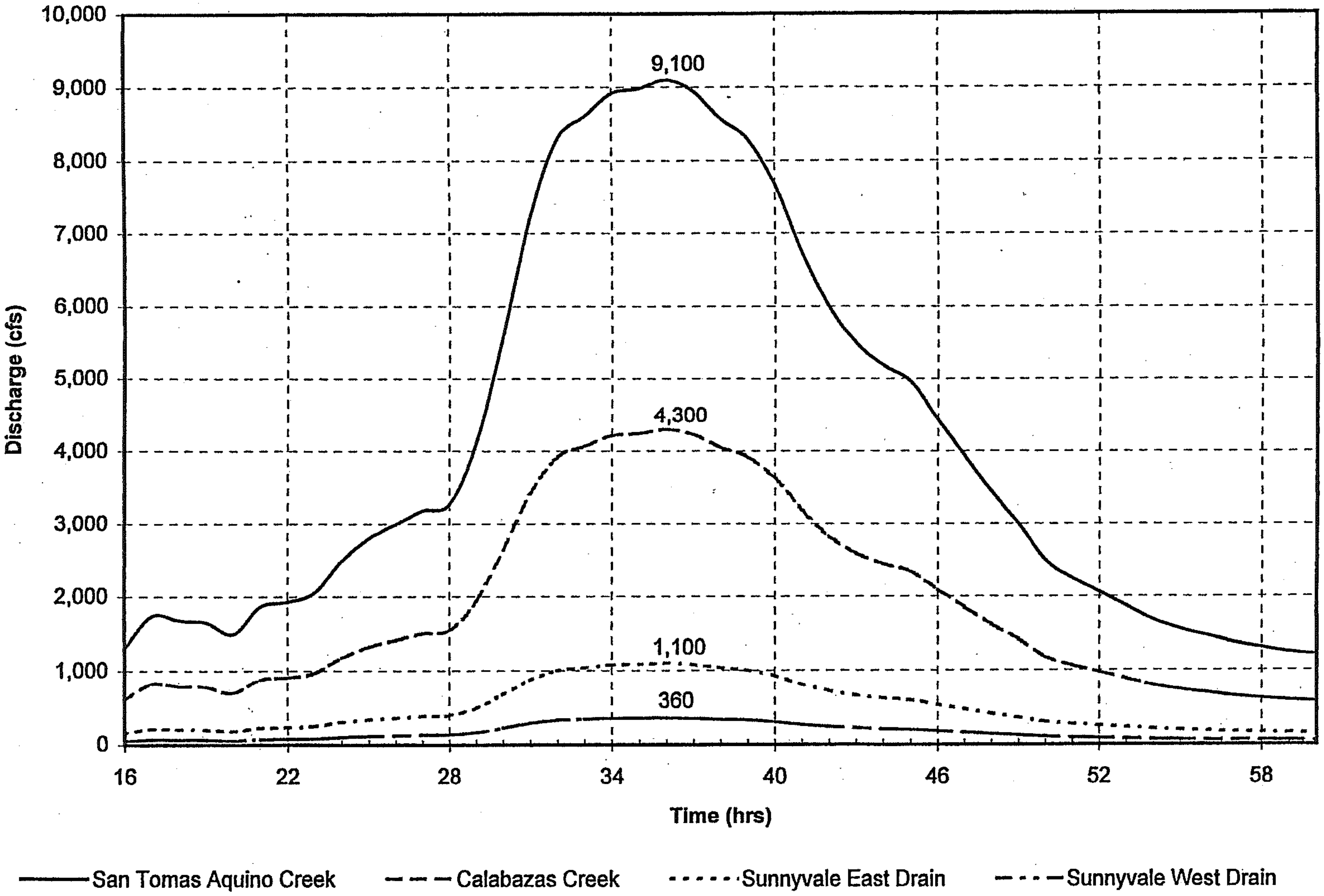


Figure 20
Design Tide at Dumbarton Bridge

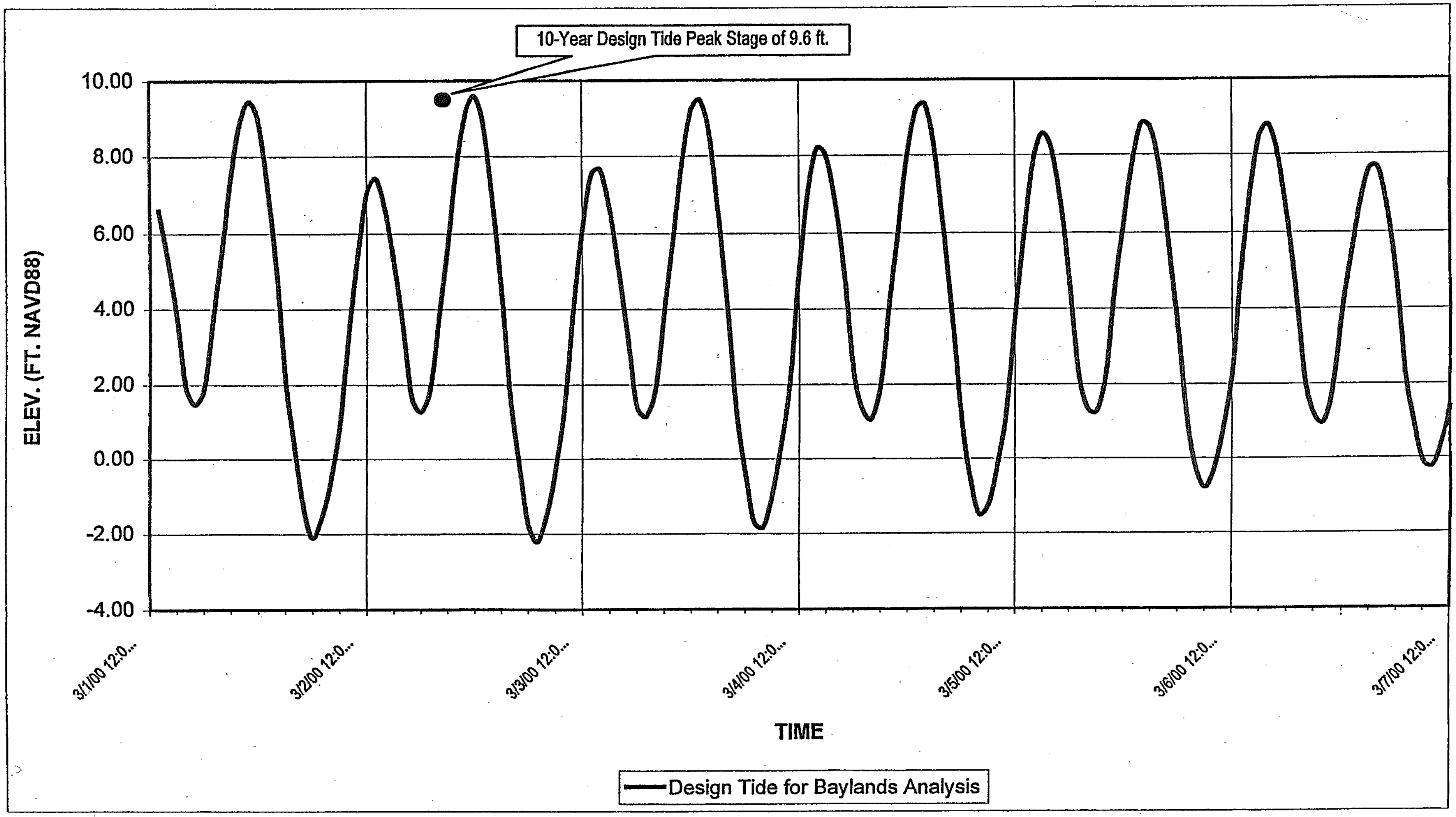
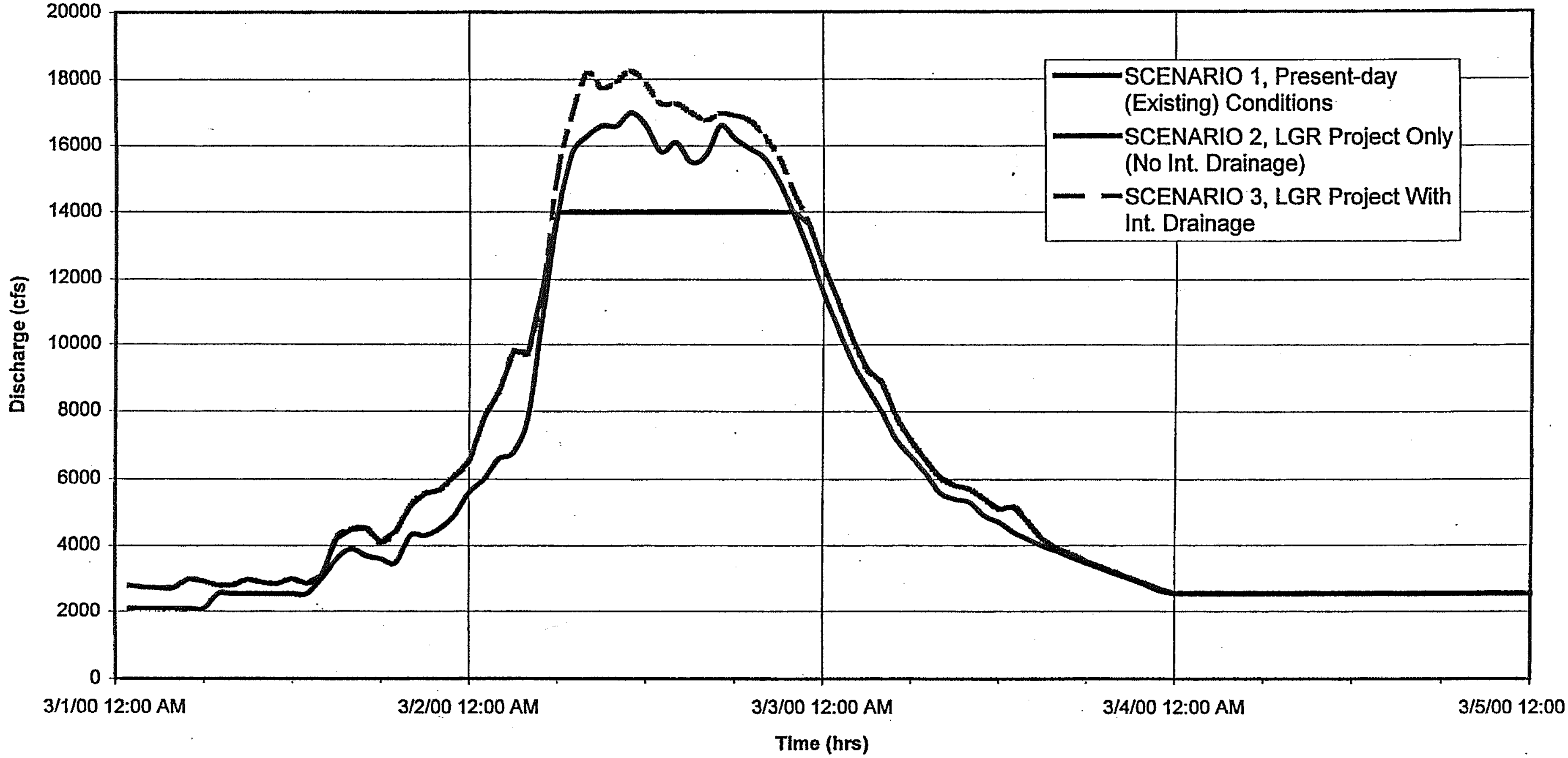


Figure 21
Lower Guadalupe River Hydrographs Used in Baylands Modeling



The previous discussions summarize those key results and analyses of the Baylands that have been performed to date as part of on-going planning investigations for the Lower Guadalupe River Flood Control Project. Results may be limited by the accuracy of available data and the assumptions used to depict various hypothetical flow conditions, levee configurations and boundary conditions. These results are not intended for design or construction.

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Loren Murray
01/11/2002 07:55 PM

To: drueden@ch2m.com, leverett@ch2m.com
cc: Robert MacArthur@NHC, Jeff Johnson@NHC
Subject: LGRFPP - Addendum Information to the December Memo

Dave & Ben -

I've faxed my markup edits on the District-to-Cargill draft letter to Dave. I filled in the numbers where appropriate. However, the information provided below will likely require some additional information to be added to the previous memo.

After incorporating the refined overflow weir (1000 lf) into UNET, I've rerun the model for two scenarios - they are:

(1) - 17k cfs from LGR, improved weir in-place, no change in height of the interior levees A8W-A5, A8W-A7, or A8W-A8D. See Figure 10.

FIGURE 10.PDF

(2) - 17k cfs from LGR, improved weir in-place, maximized heights of interior levees between A8W-A5, A8W-A7, and A8W-A8D. See Figure 11.

FIGURE 11.PDF

Here are some very important hydraulic conditions to understand when looking at these two figures:

- In Fig10, the interior ponds of A5, A7, A8W and A8D all reach a common, comingled flood elevation of about 10.8 feet. This is because there is cascading floodflows from A8W into the other cells once existing interior levees are overtopped.
- In Fig11, the highest possible interior levee A8W-A8D, built to match the crown of either Guadalupe or Alviso Slough levees as directed by Dennis, is about 13.8 feet. Nhc and SCVWD also agreed that the interior levee between A8W-A5/A7 would be maximized at 1 foot less than the A8W-A8D levee, or 12.8 feet. The model indicates that under this condition, A8W will fill to a maximum elevation of 13.5 feet, and some cascading into A5 and A7 will have occurred. Although A5 and A7 get flooded, they are flooded to a lesser depth under this scenario. The flooding in A8D is associated with Guadalupe Slough overflows, not the cascading flow from A8W since the levee is raised to a height greater than the maximum A8W pool.
- Unfortunately, A8W can't reach that flood pool elevation depicted in Pond A8W. There are significant stretches of the west Alviso Slough levee crown between the weir and that A8W-Alviso Sl. levee intersection point downstream that are below the 13.5-foot peak elevation.
- The Reconnaissance Study Model was never coded in that magnitude of detail to assess the complete filling of a large pond (like A8W). Several low spots in the levee profile were coded to identify when Alviso Slough leaks out into the ponds, but NO pond was coded up to identify all of its potential leaks.

- This whole idea of maximizing the storage in Pond A8W to provide extra benefits to A5 and A7 presumes that ALL levees containing storage remain intact. There is no evidence at present that supports this assumption. If maximizing the pool stage in A8W initiates a levee failure back into Alviso Slough, localized scour and energy concentrated against the east levee bank could induce its failure. (Refer to earlier memorandum reporting explaining the ramifications of a levee failure to the east of Alviso Slough). With this kind of failure, either/both interior salt pond areas (east and west of Alviso Slough) could be opened up to a tidal prism. This means that you couldn't drain out the interior lands until both failure openings are patched, and then pumping of the flooded interior could commence.

I suggest we talk on Monday morning about how to address these shortcomings to the mitigation component of the LGR project.

Loren A. Murray, P.E.
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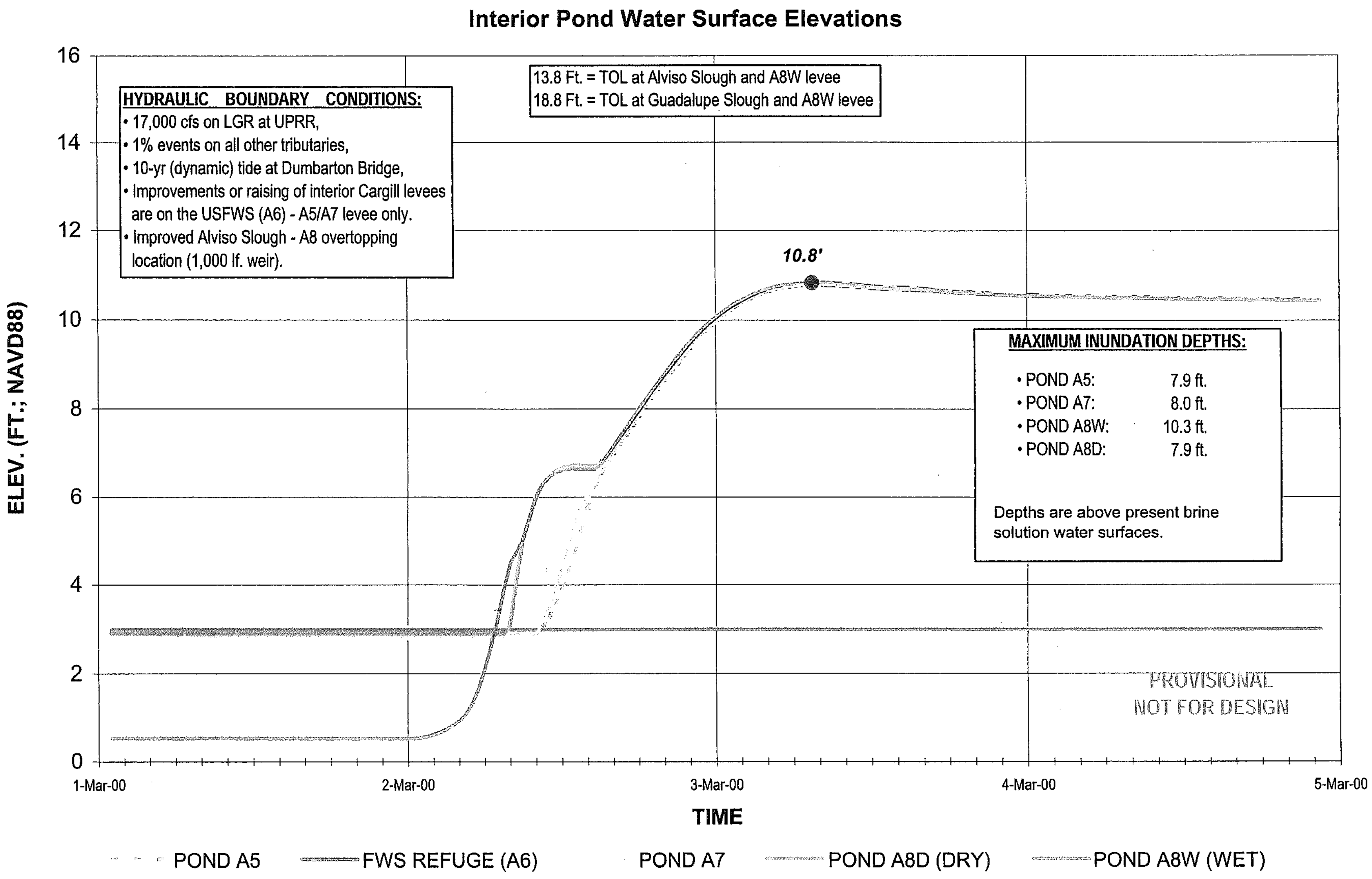


HYDRAULIC BOUNDARY CONDITIONS:

- 17,000 cfs on LGR at UPRR,
- 1% events on all other tributaries,
- 10-yr (dynamic) tide at Dumbarton Bridge,
- Improvements or raising of interior Cargill levees are on the USFWS (A6) - A5/A7 levee only.
- Improved Alviso Slough - A8 overtopping location (1,000 lf. weir).

13.8 Ft. = TOL at Alviso Slough and A8W levee
18.8 Ft. = TOL at Guadalupe Slough and A8W levee

MAXIMUM INUNDATION DEPTHS:

• POND A5:	7.9 ft.
• POND A7:	8.0 ft.
• POND A8W:	10.3 ft.
• POND A8D:	7.9 ft.

Depths are above present brine solution water surfaces.

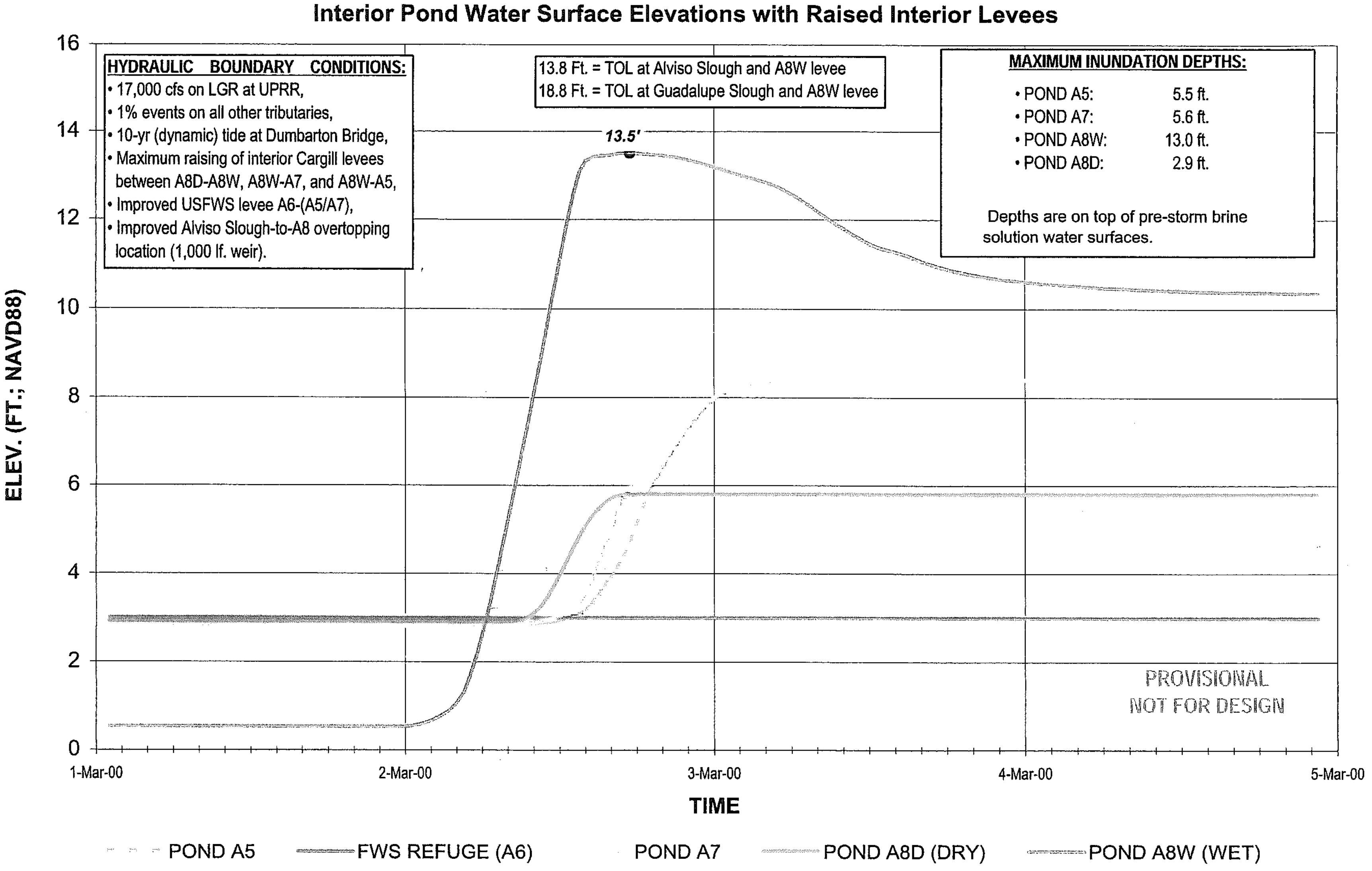
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT

FIGURE 10

INUNDATION DEPTHS TO CARGILL PONDS A5-A8 AND USFWS REFUGE (A6)

SUPPLEMENTAL BAYLANDS HYDRAULIC ASSESSMENT

JANUARY 2002



Interior Pond Water Surface Elevations with Raised Interior Levees

HYDRAULIC BOUNDARY CONDITIONS:

- 17,000 cfs on LGR at UPRR,
- 1% events on all other tributaries,
- 10-yr (dynamic) tide at Dumbarton Bridge,
- Maximum raising of interior Cargill levees between A8D-A8W, A8W-A7, and A8W-A5,
- Improved USFWS levee A6-(A5/A7),
- Improved Alviso Slough-to-A8 overtopping location (1,000 lf. weir).

13.8 Ft. = TOL at Alviso Slough and A8W levee
18.8 Ft. = TOL at Guadalupe Slough and A8W levee

MAXIMUM INUNDATION DEPTHS:

• POND A5:	5.5 ft.
• POND A7:	5.6 ft.
• POND A8W:	13.0 ft.
• POND A8D:	2.9 ft.

Depths are on top of pre-storm brine solution water surfaces.

PROVISIONAL
NOT FOR DESIGN

LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT

FIGURE 11

INUNDATION DEPTHS TO CARGILL PONDS A5-A8 AND USFWS REFUGE (A6)

SUPPLEMENTAL BAYLANDS HYDRAULIC ASSESSMENT

JANUARY 2002

Memorandum for Record

northwest hydraulic consultants
3950 industrial boulevard, suite 100c
west sacramento, ca 95691
(916) 371-7400
(916) 371-7475 (fax)

Date:	January 3, 2002	Project:	A2248 / A2248A
To:	David Von Rueden		
Company/Agency:	CH2M Hill, San Jose, California.		
From:	Loren A. Murray and Robert C. MacArthur, nhc		
Cc:	Jeff Johnson, nhc		
Project:	Lower Guadalupe River Flood Protection Project, Summary of Recent Supplemental Baylands Reconnaissance Analysis, nhc 50198.		
Subject:	Follow-up information requested during the 10 December 2001 meeting with Cargill.		

Representatives from the SCVWD, CH2M Hill (CH2M), Northwest Hydraulic Consultants (NHC), Schaff and Wheeler and Cargill Salt met at Cargill's offices in Freemont at 10:00 a.m. on December 10, 2001, to discuss issues pertaining to the District's Draft EIR and Engineer's Report. The following items were discussed:

1. Baylands modeling approach, assumed boundary conditions, including tides, flows, channel capacity, model extent (aerial coverage), and channel geometry;
2. Definition of "existing" or baseline conditions, "with-LGR Project" Conditions, and hydraulic criteria used in the analyses;
3. Baylands mitigation alternatives that have been considered and/or evaluated by the District and CH2M.

During the discussions, it became apparent that Cargill and Schaff and Wheeler were unable to find the level of detail they needed to address their concerns for the above topics in the Draft EIR or Engineer's Report. A substantial Reconnaissance study and additional modeling analyses were completed by the study team to support the ER and EIR. However, many of the details were not attached with the ER or EIR. Therefore, this memo is intended to provide additional technical information on Baylands studies completed to date to supplement that which is found in the EIR or Engineer's Report. All attending the meeting agreed to review these materials and that they would meet again if necessary to discuss remaining issues or questions.

1. Analysis Approach and Boundary Conditions

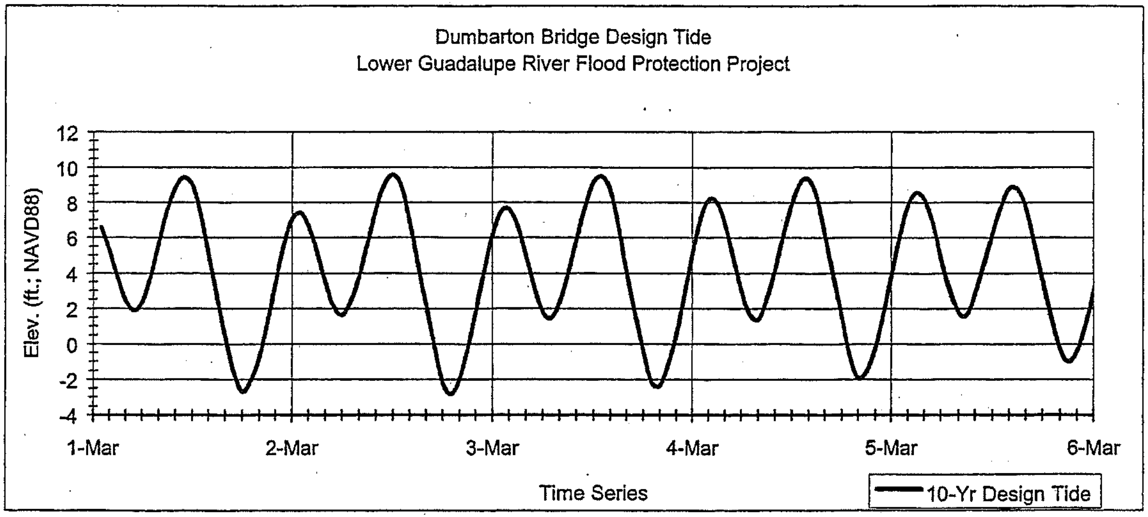
The baylands study area encompasses some twenty-five± square miles and is shown in Figure 1. An unsteady, one-dimensional UNET model was developed to simulate the hydrodynamic characteristics of the baylands study area. Figure 2 shows potential flood-prone areas (treated as storage cells in UNET modeling), local tributaries, and identifies commonly used names for specific areas (Cargill ponds, refuges areas, etc.). Figure 3 is a schematic diagram of how the UNET model represents various hydrologic and hydraulic components of the baylands study area.

The model boundary conditions for the baylands study area include:

- The downstream boundary condition for the baylands model is the South San Francisco Bay tide at Dumbarton Bridge;
- The upstream boundary condition for Coyote Creek inflow is a four-day, single-event flood hydrograph;
- The upstream boundary condition for Alviso Slough inflow is the Corps of Engineers' four-day, single-event flood hydrograph from the Lower Guadalupe River;
- The upstream boundary condition for Guadalupe Slough is a four-day, single-event hydrograph on each of four tributaries delivering runoff into Guadalupe Slough;
- Geometry for Alviso Slough was based on 1996 SCVWD and 1998 Cargill surveys;
- Geometry for Guadalupe Slough was based on 1970's SCVWD surveys;
- Geometry for Cargill salt evaporator ponds was based on cumulative data collected by Leslie Salt and Cargill Salt throughout the 1970-1990's timeframe;
- Geometry for Lower Coyote Creek was based on bathymetry shown on USGS Quadrangle mapping;
- Starting water surfaces (brine solution) in Cargill ponds based on 1998 Cargill surveys.

A more detailed description of the dynamic boundary conditions is provided in the following paragraphs:

Dumbarton Tide – The downstream water surface elevation is controlled by tidal elevations in South San Francisco Bay at Dumbarton Bridge. Peak tidal stage and design flood peak discharge were synchronized to coincide at the same time ordinate over the duration of event simulation. Tidal stage and frequency relationships were obtained from the Corps of Engineers (*U.S. Army Corps of Engineers San Francisco District, San Francisco Bay Tidal Stage vs. Frequency Study, October 1984*). A 10-year tide in conjunction with a 1-percent flood event is the basis for design. This is consistent with recommendations from the Corps of Engineers and SCVWD. The following figure shows the design tidal series used in the unsteady modeling of the baylands study area.



Alviso Slough – Two peak discharge events were used to evaluate hydraulic performance of the study area. The existing conditions and design event hydrographs are shown in Figure 4.

The existing (today's) condition was represented by the Corps' LCA[1] hydrograph shape with a 14,000 cfs peak discharge rate. This is the largest discharge that can reach UPRR under present-day Guadalupe River channel capacity conditions upstream of UPRR.

The design event was represented by the Corps' LCA hydrograph with a peak discharge of 17,000 cfs. This is SCVWD's design discharge delivered to UPRR by the proposed Lower Guadalupe River Flood Control Project.

Coyote Creek – The one-percent design hydrograph developed and used by the Corps of Engineers to construct the Coyote Creek Project was also used for the baylands analysis. As was specified for the baylands modeling, the Corps project also used a 10-year tide in conjunction with the Coyote Creek design event. The Coyote Creek design event was lagged by eleven hours (per Dr. Jim Wang, hydrologist, SCVWD) with respect to the Lower Guadalupe River design hydrograph. The Coyote Creek design hydrograph is also shown in Figure 4. Additionally, discharges from the WPCP Treatment Plant just northeast of Alviso were included as flows into Coyote Creek upstream of the UPRR crossing north of Alviso.

Guadalupe Slough – The inflows to Guadalupe Slough are from four primary inflow sources. These sources are San Tomas Aquino Creek, Calabazas Creek, Sunnyvale East Drain and Sunnyvale West Drain. SCVWD provided one-percent event peak discharge rates for these tributary sources. Hydrographs for each tributary were synthesized using the shape of the Guadalupe River hydrograph (upstream of the Los Gatos Creek confluence; i.e. single flood wave event), and scaled by the peak discharge rates to develop the full time-series hydrographs. These hydrographs were not lagged with respect to the Guadalupe River design hydrograph. Figure 5 shows the design hydrographs for these four tributaries.

---

[1] The U.S. Army Corps of Engineers and SCVWD Local Cooperation Agreement (LCA) incorporates the adoption of the Corps 1977 Hydrology prescribing the design event hydrograph.

2. Existing- and With-LGR Project Conditions and Analysis Criteria

The following summarizes the SCVWD hydraulic criteria for the baylands reconnaissance-level analysis.

Existing Conditions – The following criteria were applied to represent existing (today's) conditions in the baylands study area:

- 10-Year tide at Dumbarton bridge with the peak tide stage occurring coincident with the Lower Guadalupe River peak discharge at UPRR;
- A Guadalupe River single event, 4-day hydrograph with a peak discharge of 14,000 cfs at UPRR;
- The one-percent event design hydrograph on Coyote Creek, with its peak lagged by 11 hours with respect to the Guadalupe River peak;
- One-percent events on the four tributary inflows to Guadalupe Slough;
- No storm nesting or antecedent conditions which would have created flooding or storage in any of the model's cells prior to the single event simulation;
- Guadalupe Slough geometry based on available 1981 SCVWD HEC-2 modeling (from surveys taken in the 1970's);
- Alviso Slough geometry based on 1996 SCVWD surveys and HEC-2 modeling supplemented with levee profiles collected by Cargill (Thinggaard, P.L.S.) in 1998;
- Alviso Slough overflow location geometry based on 1998 Cargill (Kier & Wright, P.L.S.) surveys;
- Coyote Creek geometry based on 1960± bathymetric mapping available from USGS, NOAA and others;
- Starting water surface elevations in the Cargill salt ponds are normal operating condition brine solution water surface elevations (These operational pond elevations are based on 1998 Cargill [Thinggaard, P.L.S.] surveys);
- The dry portion of Cargill Pond A8 (designated A8D for "Dry") starting elevation is the ground elevation in that particular cell.
- The U.S. Fish & Wildlife Refuge cell (formerly Pond A6) is isolated by recent levee raising activities, and its connection to ponds A5 and A7 is limited by the estimated levee crown elevations.

With-LGR Project Conditions – The following criteria represent the With-LGR Project design conditions in the baylands study area. For various alternatives, geometry and/or model connectivity were modified to depict the operational conditions of each alternative.

- A 10-Year tide at Dumbarton bridge with the peak tide stage occurring coincident with the Lower Guadalupe River peak discharge at UPRR;
- A Guadalupe River single event, 4-day hydrograph with a peak discharge of 17,000 cfs at UPRR;
- The Guadalupe River design event excludes City of San Jose, City of Santa Clara and Caltrans pumping of interior stormwater runoff from the watershed between I-880 downstream to UPRR into the Guadalupe River;

- The one-percent event Corps of Engineers design hydrograph on Coyote Creek, with its peak lagged by 11-12 hours with respect to the Guadalupe River peak;
- One-percent events on the four tributary inflows to Guadalupe Slough;
- Santa Clara County modifications to the Marina in Alviso are completed, raising the parking lot and perimeter levees to prohibit flooding into the Town of Alviso;
- An improved overflow zone (modeled as a weir) at the same location near Cargill pond A8 across from Alviso (the purpose is to remove any chance of this location eroding or being scoured out as a result of the higher overtopping flows generated by the design event);
- No storm nesting or antecedent conditions which would have created flooding or storage in any of the model's cells prior to the single event simulation;
- Unless specifically modified for project conditions, antecedent or geometric conditions are identical to those specified for existing conditions.

3. Past Baylands Studies Performed for SCVWD

Beginning in 1998, several hydraulic and environmental reconnaissance studies have been performed which support the development of baseline and possible LGR project mitigation features. Key reports and Memos include:

- *Sediment Transport and Water Quality Modeling of the Knapp Unit of the Don Edwards San Francisco Bay National Wildlife Refuge Complex*, Department of Civil and Environmental Engineering, University of California, Davis, California, February 1998.
- *Preliminary Geomorphic and Hydrodynamic Assessment of The Guadalupe River, Alviso Slough, Guadalupe Slough and Its Tributaries, and the Cargill Salt Pond System,* Northwest Hydraulic Consultants, Inc., June 1998.
- *Calculation of Effective Suspended Solids Concentrations in Alviso Slough, California,* R.B. Krone & Associates, June 1998.
- *Calculation of Effective Suspended Solids Concentrations in Guadalupe Slough, California,* R.B. Krone & Associates, November 1998.
- *Draft Reconnaissance Report – Engineering and Environmental Reconnaissance Studies of the River Reach from UPRR to the Bay*, Northwest Hydraulic Consultants, Inc., June 2000.
- *Draft Engineer's Report, Lower Guadalupe River Planning Study*, CH2M Hill, August 2001.
- *Draft Environmental Impact Report, Lower Guadalupe River Planning Study*, Jones & Stokes, Inc., August 2001.
- Twelve SCVWD supplemental baylands analyses assignments (Oct. 2000 through Dec. 2001) subsequent to the completion of the Draft Reconnaissance Report.
- Responses to questions raised by Schaff and Wheeler in letter of 10-15-01.

Summary Results of Alternatives Analyses – Several alternative scenarios have been evaluated to assess flooding impacts in the baylands. Some of these scenarios include: existing conditions, a variety of modifications along Alviso Slough, the dredging of an auxiliary waterway from Alviso to the bay (the "Bob Gross alternative"), managing flood volumes within Cargill ponds A5-A8, returning A5-A8 back into salt marsh habitat, isolating and maximizing Cargill pond A8 storage, and sizing of the Pond A8 improved overflow for no-net increase to downstream conditions (water surface profiles) in Alviso Slough. The results exclude long-term impacts associated with sea-level rise, possible future subsidence and levee settlement in the region. All reconnaissance results are provisional, and are not suitable for design purposes.

Existing Conditions – Under present-day conditions, the analyses indicate that inundation to Cargill ponds A5-A8 could range from ~6 feet to ~8 feet on top of present operating brine solution water surfaces. Floodwaters spill into ponds A5-A8 and A3E from both Guadalupe Slough and Alviso Slough during high flows. The following table (at the right) shows the estimated impacts in terms of depth of flooding above the pre-storm brine surface elevation in ponds A3E, A5, A7, and A8W (A8D starting elevation is the dry pond's invert). Recent improvements by the USFWS Refuge have raised the levee between A5/A7 and A6 to reduce the chance of overflows from A5 and/or A7 into A6.

Existing Conditions Inundation Impacts
(for a 14,000 cfs LGR event)

Flooding by Location	Depth (ft)
Cargill Pond A5	5.8
FWS Refuge (A6)	-
Cargill Pond A7	5.8
Cargill Pond A8W (Wet)	8.1
Cargill Pond A8D (Dry)	5.8
Cargill Pond A11	-
Cargill Pond A12	2.1
Cargill Pond A13	2.5
Cargill Pond A15	1.4
Cargill Pond A16	-
Cargill Pond A17	3.3
Cargill Pond A3-East	0.1
Cargill Pond A3-West	-

The primary source of Alviso Slough flood water entering the ponds is at the low spot in the Cargill A8 pond levee across from Alviso. The flow split during the peak discharge of 14,000 cfs entering Alviso Slough is approximately 9,700 cfs continuing downstream and out to the bay, while the remaining 4,300 cfs spills into ponds A5-A8. The duration of spill is around 30± hours, and results in approximately 9,950 acre-feet of spill into ponds A5, A7 and A8.

That's what [illegible] Guadalupe [illegible] by [illegible] the [illegible]

Design Conditions – When the Lower Guadalupe River (LGR) flood event is increased to the 17,000 cfs peak design event, (and all other boundary conditions remain the same as under existing conditions) and with Pond A8 overflow location and Marina improvements only downstream of UPRR, the inundation depths increase by approximately ¾ to 1 foot, to a range of 6 - ½ feet to 9 feet above pre-storm brine surface

Design Event Inundation Impacts
(for a 17,000 cfs LGR event)

Flooding by Location	Depth (ft)
Cargill Pond A5	6.7
FWS Refuge (A6)	-
Cargill Pond A7	6.8
Cargill Pond A8W (Wet)	9.1
Cargill Pond A8D (Dry)	6.7
Cargill Pond A11	-
Cargill Pond A12	1.8
Cargill Pond A13	2.2
Cargill Pond A15	1.4
Cargill Pond A16	-
Cargill Pond A17	3.3
Cargill Pond A3-East	0.1
Cargill Pond A3-West	-

elevations. The table at the right shows the estimated inundation impacts to the ponds for the design event without any actions to reduce or diminish the impacts.

The primary source of Alviso Slough floodwater entering the ponds is outflow at the same low spot across from Alviso. The flow split during the peak discharge of 17,000 cfs (with Pond A8 overflow improvements only in the baylands) entering Alviso Slough is approximately 10,900 cfs continuing downstream and out to the bay, while the remaining 6,100 cfs spills into ponds A5-A8. The duration of spill is about 30± hours, and results in approximately 10,950 acre-feet of spill into ponds A5, A7 and A8.

Dredging Alviso Slough – Dredging Alviso Slough to increase the hydraulic capacity was assessed during the Reconnaissance Study, but was dismissed because this option provided nominal hydraulic benefits (because the entire slough is tidally controlled), would induce significant adverse environmental impacts to habitat and sensitive species along the slough corridor, and would require significant and costly annual maintenance to remove sediment. Excluding sediment transport processes depositing terrestrial materials from the Lower Guadalupe River, marsh accretion processes will deposit between 0.25 to 0.5 feet of material into the dredged channel annually.

New Channel Construction – The construction of a new navigational channel from Alviso to the bay was presented in Chapter 4 of the Draft Engineer's Report. This alternative was dismissed since it provided nominal hydraulic benefits, had a high capital cost (~$65 million plus mitigation and right-of-way costs), and required substantial and costly maintenance. For more information, refer to page 4-24 in the Draft Engineer's Report.

Marsh Restoration – This scenario raised the invert surfaces of ponds A5-A8 up to mean higher high water, and opened the entire northwest levee boundary of A6 to the bay. This area was modeled as a routing reach for Alviso Slough and Guadalupe Slough overflows. The A8 overflow location was improved (similar to other alternatives) to protect it from erosion or scour during overtopping events. None of the Alviso or Guadalupe Slough levees were removed for this analysis, and the mechanics of restoring the marsh plain were not analyzed. Results of this scenario indicated a rise in the starting water surface elevation for the LGR Project by approximately 1 to 1-½ feet (near Gold Street). The alternative was dismissed because land acquisition costs would be excessive, and the marsh accretion processes would take anywhere from 30 to 50 years to successfully re-establish a salt marsh plain at mean-higher-high water. NHC recommended that this alternative be considered and refined further as a potential ultimate marsh reclamation alternative some time in the future.

Alviso Slough Modifications – In order to improve conveyance capacity downstream of UPRR, modifications to the Alviso Slough levees and to the A8 overflow (weir) location were assessed. These modifications considered raising the levee and overflow weir elevations to reduce overflow into the salt ponds. Specifically, modifications to Alviso Slough levees and/or overflow included:

- Raising the levees to carry the entire design discharge to the bay;
- Raising the overflow crest elevation by one foot to gain some flood protection to Cargill ponds;
- Raising the overflow crest elevation by three feet to gain flood protection to Cargill ponds.

Maximum water surface profiles for these scenarios are shown in Figure 6. The figure shows that by raising both Alviso Slough levees to prohibit any overtopping between UPRR and the bay, the water surface is raised as much as 3+ feet above the existing conditions profile. This would impact the LGR Project upstream from Alviso since the starting water surface for that project would be increased by 2.5± feet. Raising the overflow crest elevation near A8 by either 1- or 3-feet raises the water surface profile between UPRR and the overflow by about 1 foot, with a diminishing increase as you progress downstream to the bay. Significant increases in Alviso Slough levee heights may not be feasible since the levees sit on soft bay muds, and their structural integrity as non-engineered facilities is unknown. Any levee improvements would require a geotechnical investigation to determine the integrity of the levees and their underlying, subsurface conditions. The removal and replacement with engineered levees would be extremely expensive, and are likely to result in significant impacts to sensitive environmental areas along the slough corridor. Reconstructed levees would require designs that comply with recent seismic stability and wave erosion regulations.

In order to eliminate project-induced impacts downstream of the overflow location, the weir was sized to reduce the with-project conditions (Q_{LGR}=17,000 cfs) to those similar to pre-project (existing; Q_{LGR}=14,000 cfs) conditions. The lowest crest elevation was not changed, but the length of the weir was adjusted until the design conditions downstream water surface profile was comparable to the pre-project conditions, resulting in a multi-crested weir approximately 1,000 feet long. This results in an additional 2 feet of water into ponds A5, A7, and A8.

These analyses assumed that no scour or levee failures along Alviso Slough would occur, even if overtopped, for the entire duration of either an existing conditions or with-LGR design storm event. However, if overtopping were to result in a failure of Alviso Slough's right (east) levee (facing downstream), preliminary results indicate a high probability of significant flooding to Federal, private and public lands east of Alviso Slough.

Cargill Pond Flood Attenuation and Storage – The Cargill ponds A5-A8 and the U.S. Fish & Wildlife Refuge (formerly A6) act as flood storage cells during large events. As A8W fills, excess floodwaters start to cascade into A8D, then A7 and A5, and given enough time and a large enough storm event, flow can enter into A6. If the interior levees on one or more of these cells are raised to restrict or reduce overflow from adjoining cells (i.e. – from A8W into A5 or A7), the remaining cells without levee improvements end up storing more water, resulting in higher water surface elevations and greater duration of ponding in those cells.

If the Pond A8 interior levees are raised to reduce spill into Ponds A5 and A7 from A8, more flood flows remain in Alviso Slough than if flows are allowed to fill A5 and A7. NHC's assumption was that interior levees would be raised to elevations 3 feet below the tops of the main slough levees. Spills could still overtop the levees at low spots downstream of Alviso, spilling into ponds A5 (through A7), A7. Since the raised A8 levee is still lower than adjoining Alviso or Guadalupe Slough levees (to prevent induced failure of either slough's

Flood Prone Area or Cell:	Design Conditions Inundation Depth (ft) (Raised A6 Levees)	Design Conditions Inundation Depth (ft) with Raised Interior A5, A6 and A7 Levees
Cargill A5	6.7	4.6
USFWS Refuge (A6)	0.0	0.0
Cargill A7	6.8	4.6
Cargill A8W	9.1	12.7
Cargill A8D	6.7	10.3

levees), ponds A5 and A7 are also still susceptible to spills from Pond A8W, as well as overtopping spills at low spots along the Guadalupe Slough and the Alviso Slough levees downstream of Alviso. Figure 7 shows the fluctuations in pond A5-A8 water surface elevations during the design event. The table above shows the changes in inundation depth above pre-flood brine solution elevations for ponds A5, A7, A8W and A8D.

Further simulations were performed to develop a relationship between Alviso Slough peak flows versus the elevation of the interior levees at A8W and A8D to maximize storage potential if the interior A8 levees are raised to reduce the flood threat to A5 and A7. A steady-state tidal boundary condition as well as a dynamic tidal boundary condition was tested. As presented during the discussions with Cargill on 10 December 2001, maximizing the height of the A8D-A8W levee and the A8W-A5&A7 levee would provide improved flood protection to A5 and A7 for Alviso Slough events up to about a 11,300-cfs peak discharge event for a dynamic downstream boundary condition, and up to about a 10,500-cfs peak discharge event for a static downstream boundary condition. Figure 8 shows the results of this sensitivity analysis.

Gravity Outfall for Ponds A5-A8 – This analysis looked at installing uni-directional gravity drains to reduce the duration of flood storage in Ponds A5 through A8 following large flood events. The initial analysis approximated inundation durations for the impacted ponds. If no post-flood event drainage systems (gravity drains, pumps, etc.) are installed, then it might take anywhere from 20+days to 2± years (depending on the pond and depth of inundation) to remove the floodwaters by evaporation only. These estimates account for precipitation during the wet seasons within the evaporation period.

The results of installing uni-directional, 8-foot diameter gravity drains into A5, A7, A8W and A8D (one drain per cell) dropped the interior water surfaces down somewhat. The efficiency of gravity drains is reduced over time as the elevation of the ponds approach mean tide and lower tide elevations. The following table shows durations to effectively drain the ponds A5-A8 entirely by passive means (i.e. – gravity drainage only).

Pond A5-A8 Drawdown Duration by Gravity Drainage Only

Storage Cell	*Drawdown Duration (months*)*
Cargill Pond A5	~3.7
Cargill Pond A7	~4.9
Cargill Pond A8W	~6.8 – 9**
Cargill Pond A8D	~4.4
USFWS Refuge (A6; if flooded)	~2.3

* Duration estimates include the initial single 4-day storm event.
** This high-end duration is based on using an average drawdown curve slope from Ponds A5, A7 and A8D to predict duration to intercept pre-storm starting pond elevation.

This length of time to both drain the ponds and restore operability (debris removal and cleanup) for brine solution production could be close to a year. Thus, it was recommended that supplemental pumping in addition to gravity drains might be necessary to remove the remaining floodwaters from A5-A8.

Pump-assisted Gravity Outfall for Ponds A5-A8 – This analysis looked at installing pumps to supplement the uni-directional gravity drains for reducing the duration of flood storage in Ponds

A5 through A8, and completely evacuating the flood volumes from these interior storage cells. Five pumps of a particular size were specified to drain the ponds. (The analysis did not look at the impacts associated with diluting the brine solution which would result in added evaporation duration times to restore the salinity of the waters remaining in the ponds after the pumping.) Figure 9 shows the results of the inundation duration assessment for a combination of gravity drains and pumping using five (5) 25-cfs capacity pumps, and using five (5) 100-cfs capacity pumps. Long-term duration assessment accounts for precipitation over the wet season, and evaporation processes during the dry portions of the period of assessment. The addition of pumps in each cell can reduce drawdown durations significantly.

4. Additional Options Considered and Dismissed.

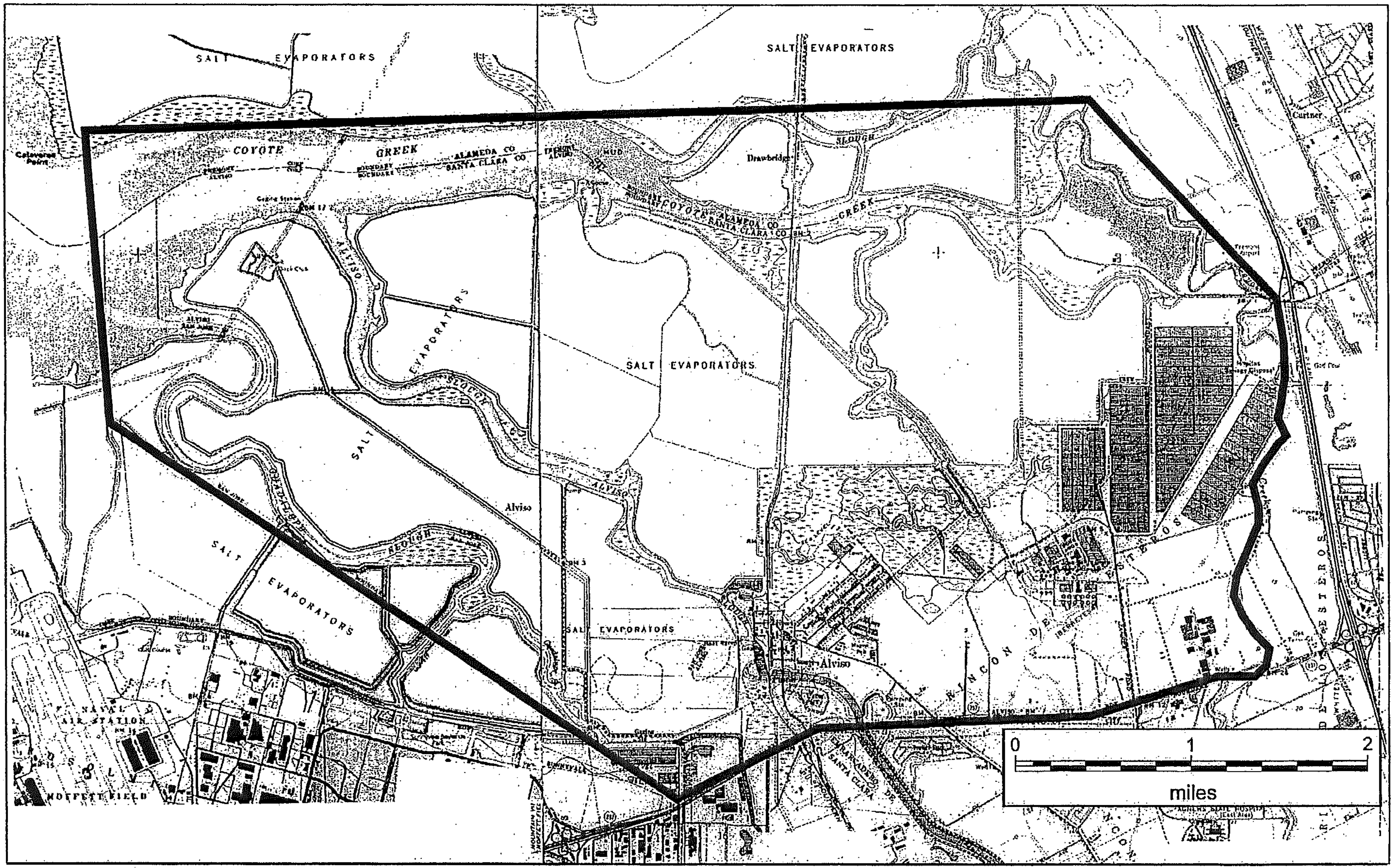
The following options were considered early in the Lower Guadalupe River project. The District, for various reasons (cost; constructability; operability; etc.), determined that these alternatives were not implementable. Therefore, no further consideration was given to these alternatives.

- Upstream floodwater storage
- Change in existing reservoir operations
- Watershed transfer
- Offstream storage

Previous analyses by the SCVWD and COE dismissed upstream storage or reservoir reoperation as viable options.

A flood flow bypass channel (or pipeline) concept to Lower Coyote Creek was given consideration, but screened out due to prohibitive costs to construct such a facility. No viable routes for even a 5,000-cfs capacity facility could be delineated. Real estate acquisition costs alone were considered extreme. The concept was also dismissed due to potential operational limitations. Transfers of Guadalupe River flows to lower Coyote Creek would require close scrutiny to ensure that the transfer would not instigate backwater (and associated induced impacts) conditions resulting in an adverse impact to the Coyote Creek Flood Control Project. Transfers of additional flood flows to Coyote Creek could worsen the potential flood threat on Cargill lands and the Town of Alviso from present-day Coyote Creek conditions.

An additional baylands alternative of bypassing some of the flows from Guadalupe River to Guadalupe Slough was considered at a conceptual level, but was dismissed due to physical and environmental limitations.



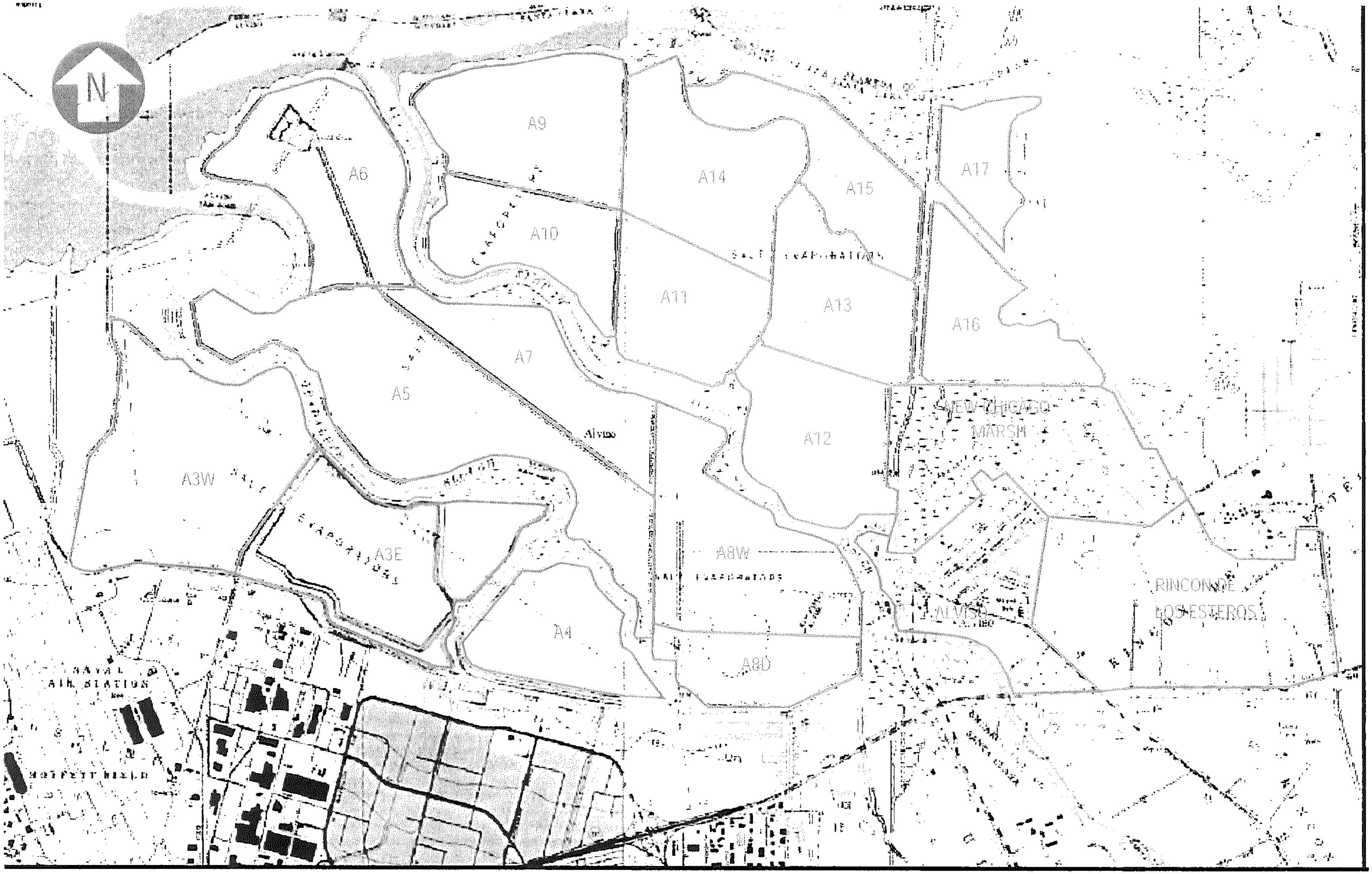
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT

FIGURE 1

GENERAL BAYLANDS STUDY AREA
SUPPLEMENTAL BAYLANDS HYDRAULIC ASSESSMENT

nhc

19 DECEMBER 2001



LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT

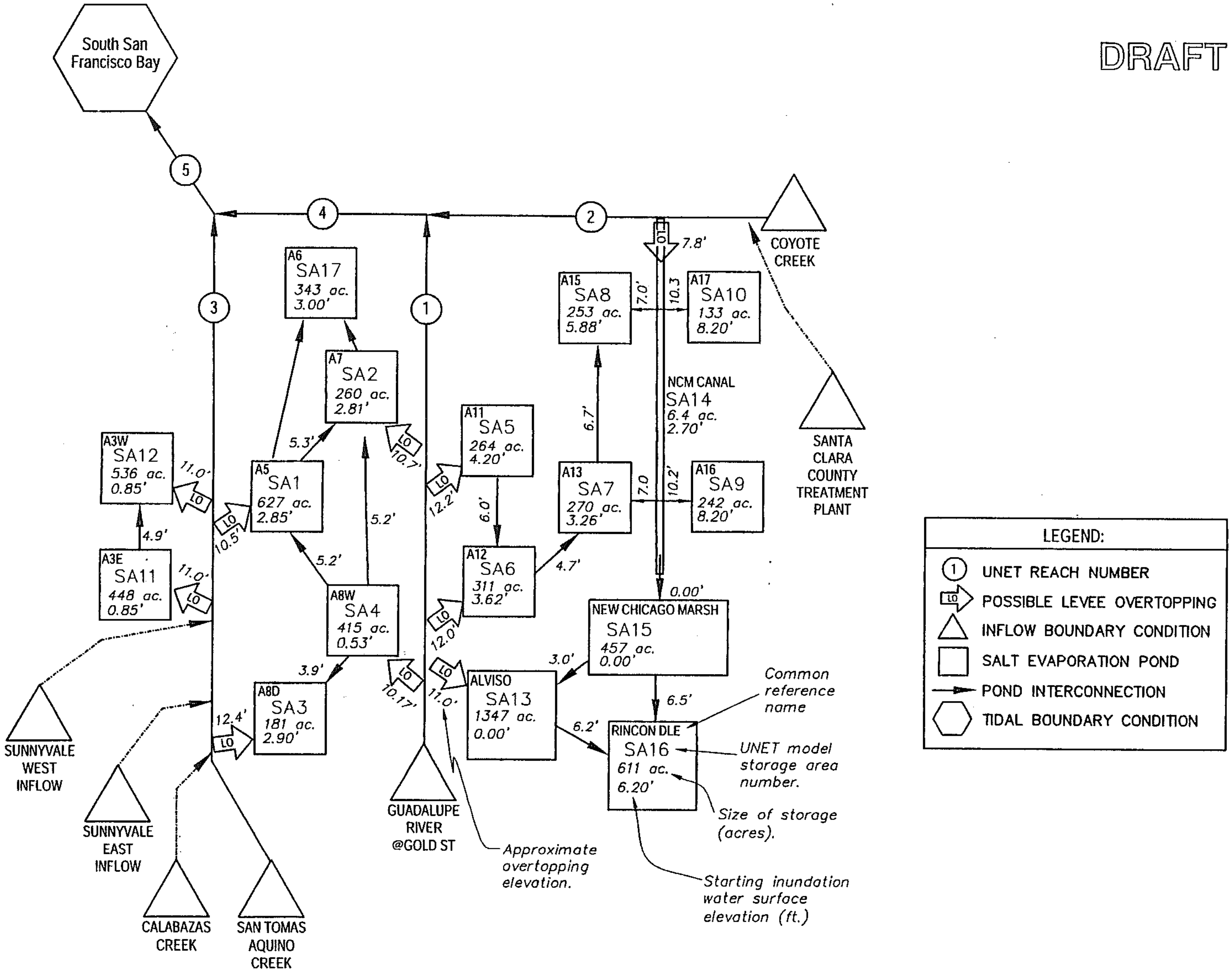
FIGURE 2

UNET MODELING STORAGE CELLS
SUPPLEMENTAL BAYLANDS HYDRAULIC ASSESSMENT

nhc

19 DECEMBER 2001

DRAFT



LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT

FIGURE 3

BASIC BAYLANDS UNET MODEL SCHEMATIC
SUPPLEMENTAL BAYLANDS HYDRAULIC ASSESSMENT

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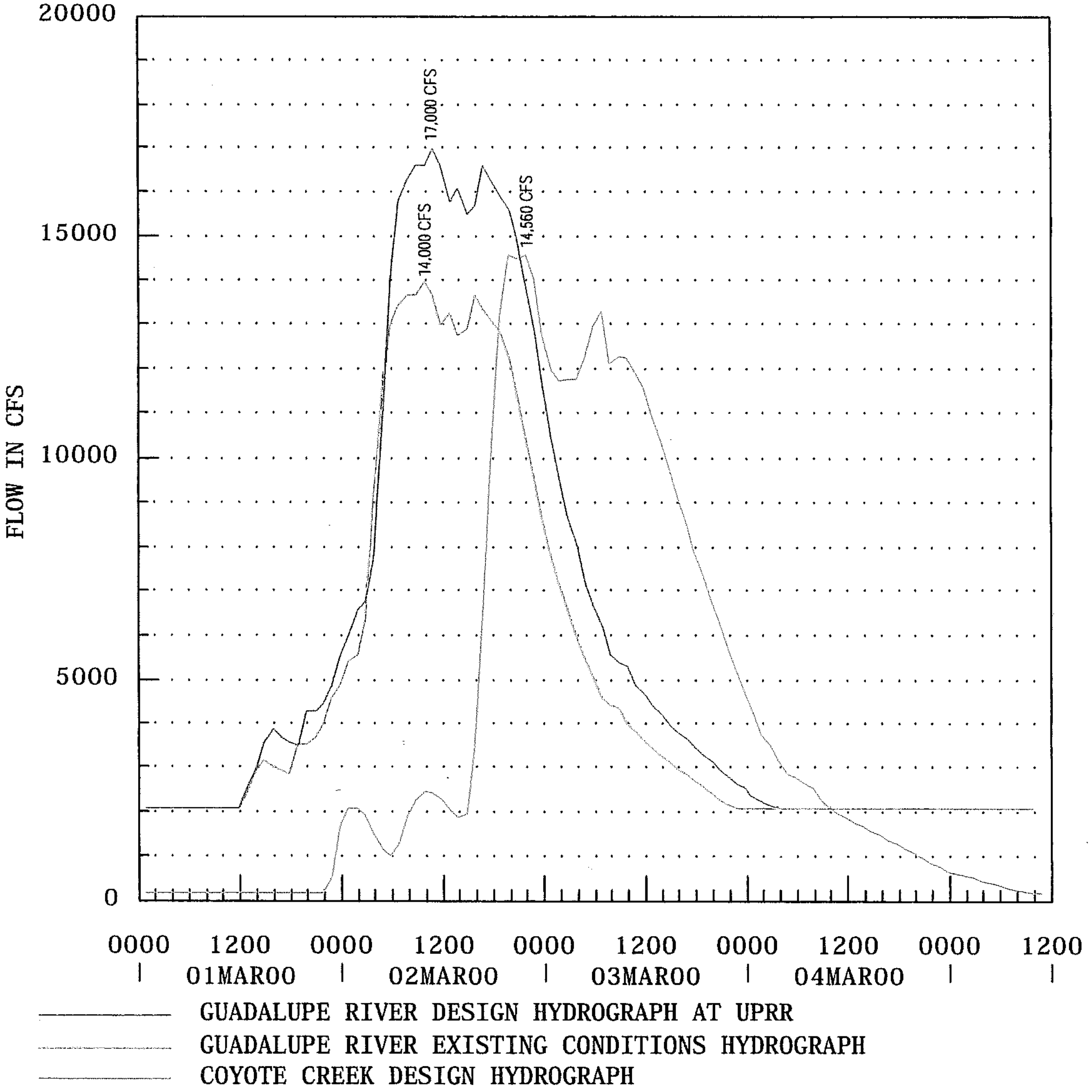

LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT

FIGURE 4

GUADALUPE RIVER AND COYOTE CREEK HYDROGRAPHS
SUPPLEMENTAL BAYLANDS HYDRAULIC ASSESSMENT

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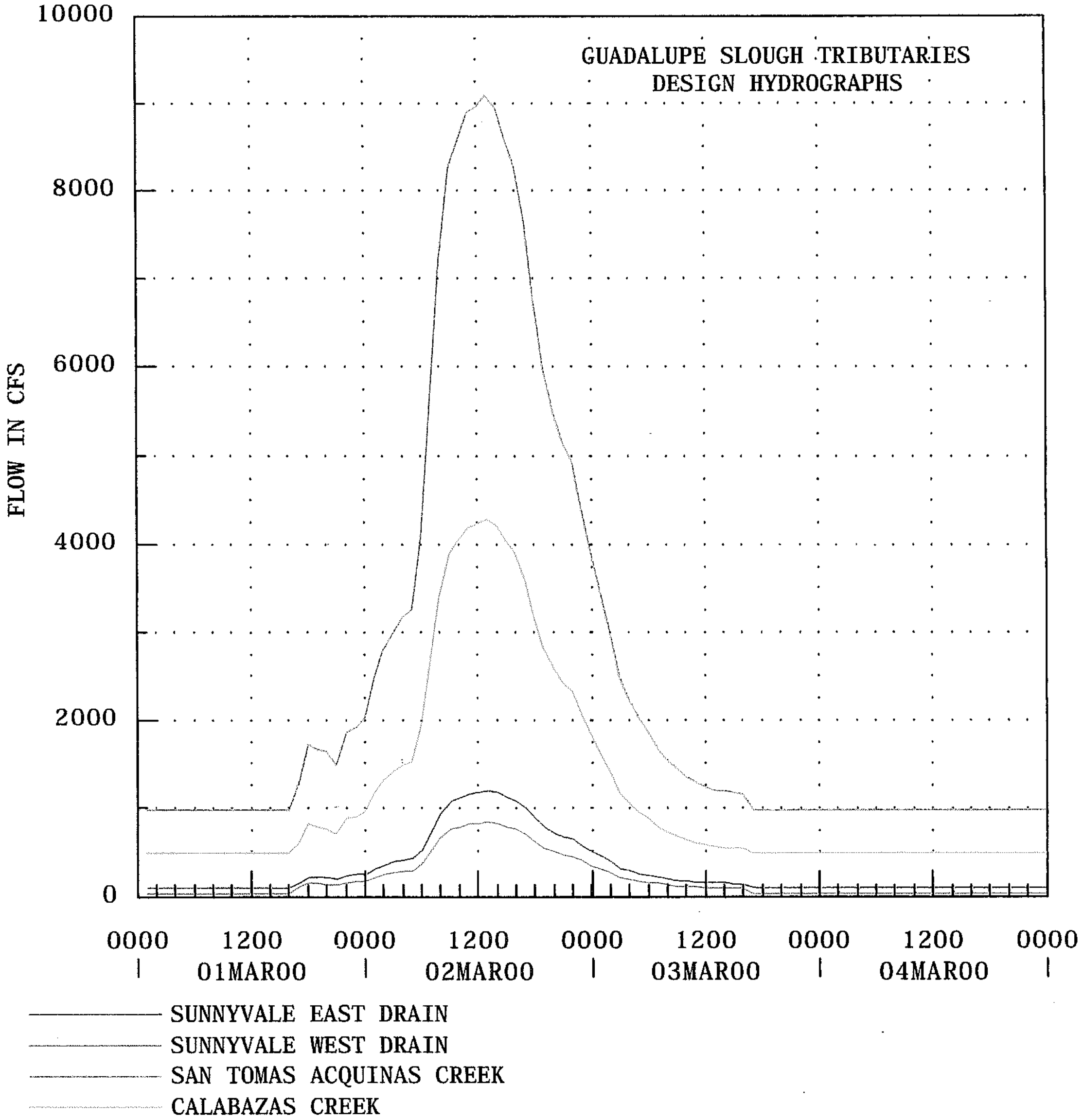

LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT

FIGURE 5

GUADALUPE SLOUGH TRIBUTARIES DESIGN HYDROGRAPHS
SUPPLEMENTAL BAYLANDS HYDRAULIC ASSESSMENT

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19 DECEMBER 2001

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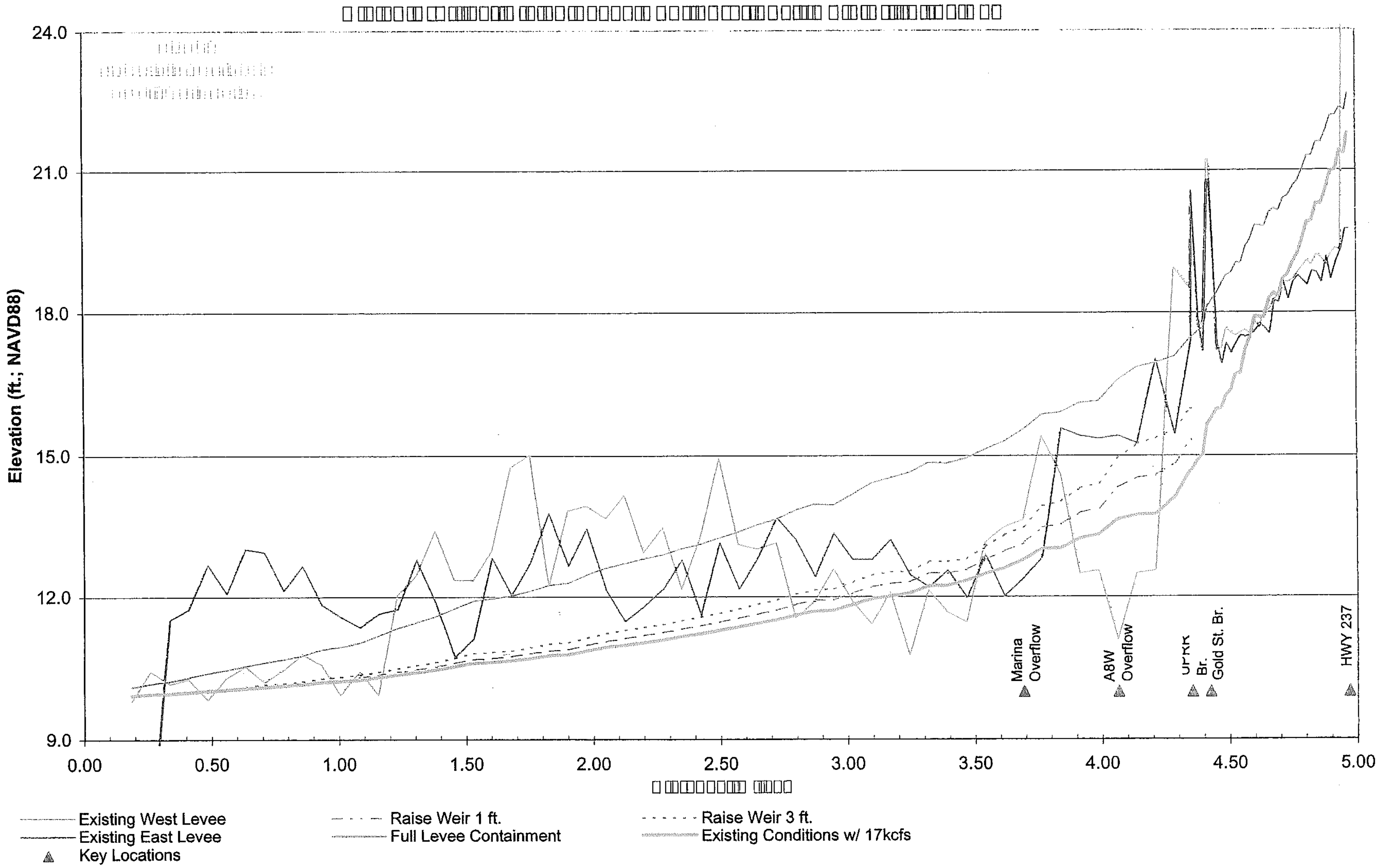

LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT

FIGURE 6

ALVISO SLOUGH WATER SURFACE PROFILES FOR VARIOUS MODIFICATIONS
SUPPLEMENTAL BAYLANDS HYDRAULIC ASSESSMENT

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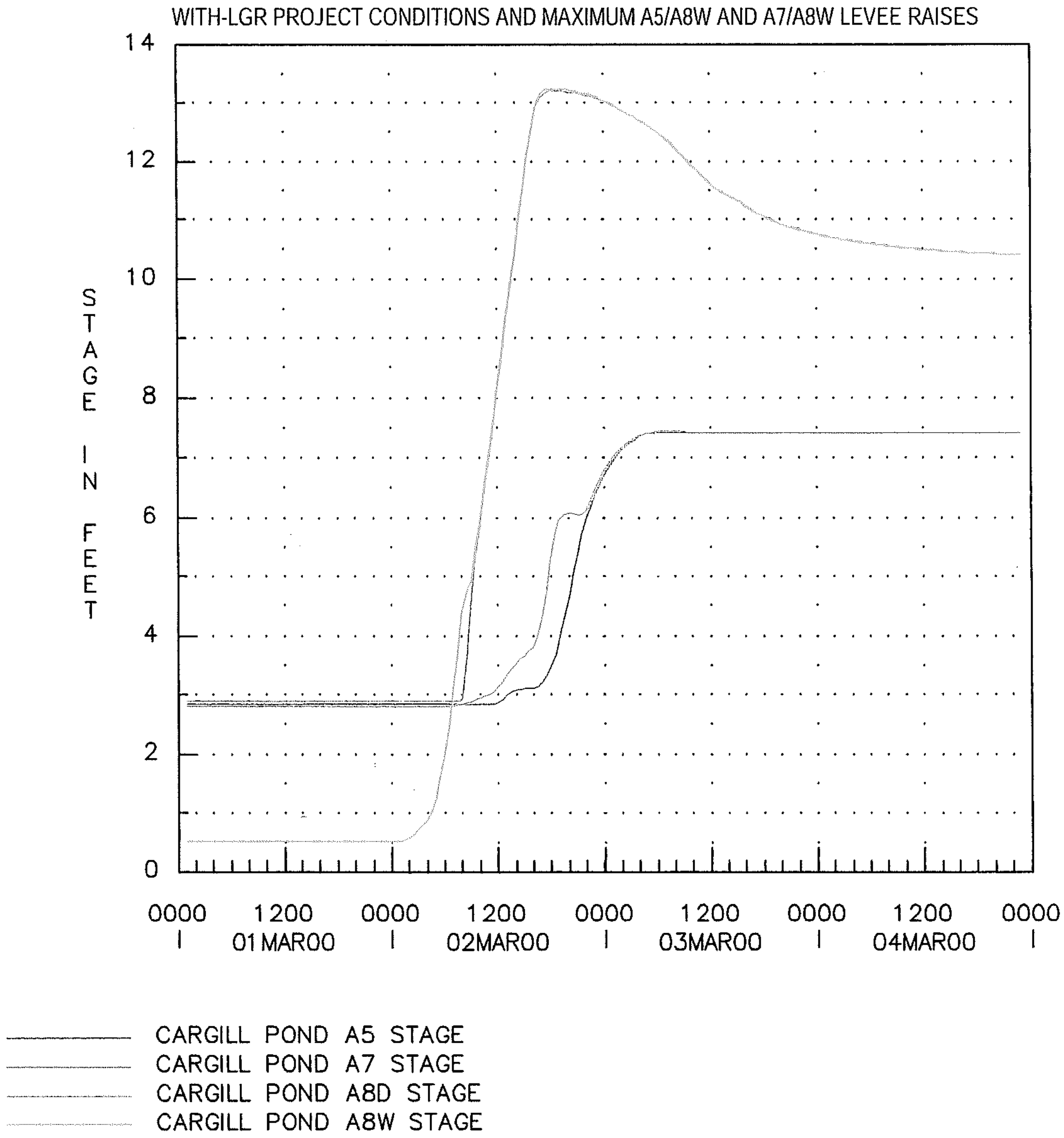

LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT

FIGURE 7

MAXIMIZING CARGILL POND A8W AND A8D
FLOOD STORAGE FROM LGR DESIGN EVENT

19 DECEMBER 2001

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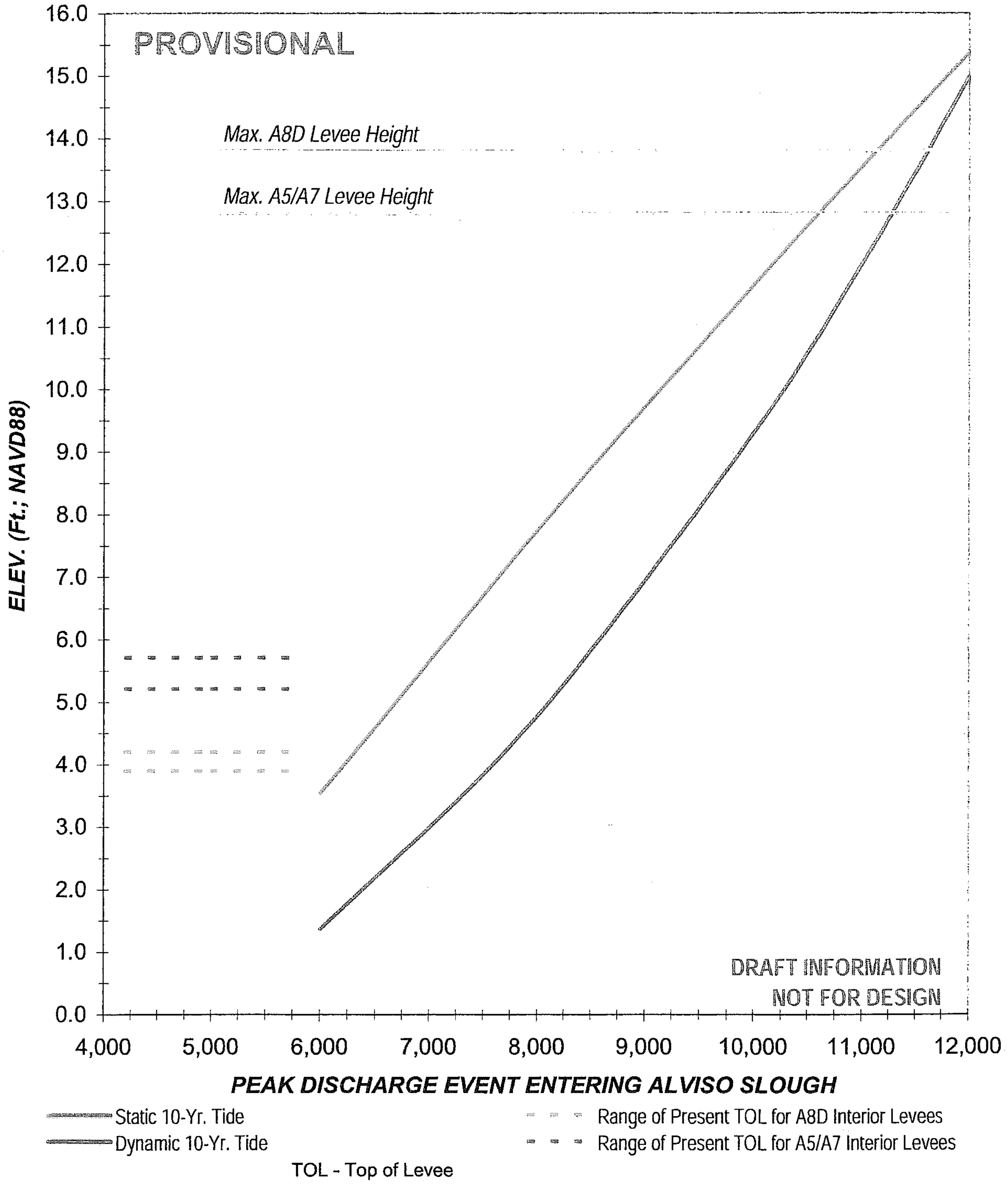
APPROXIMATE TOP OF LEVEE ELEVATIONS FOR A8W INTERIOR LEVEES

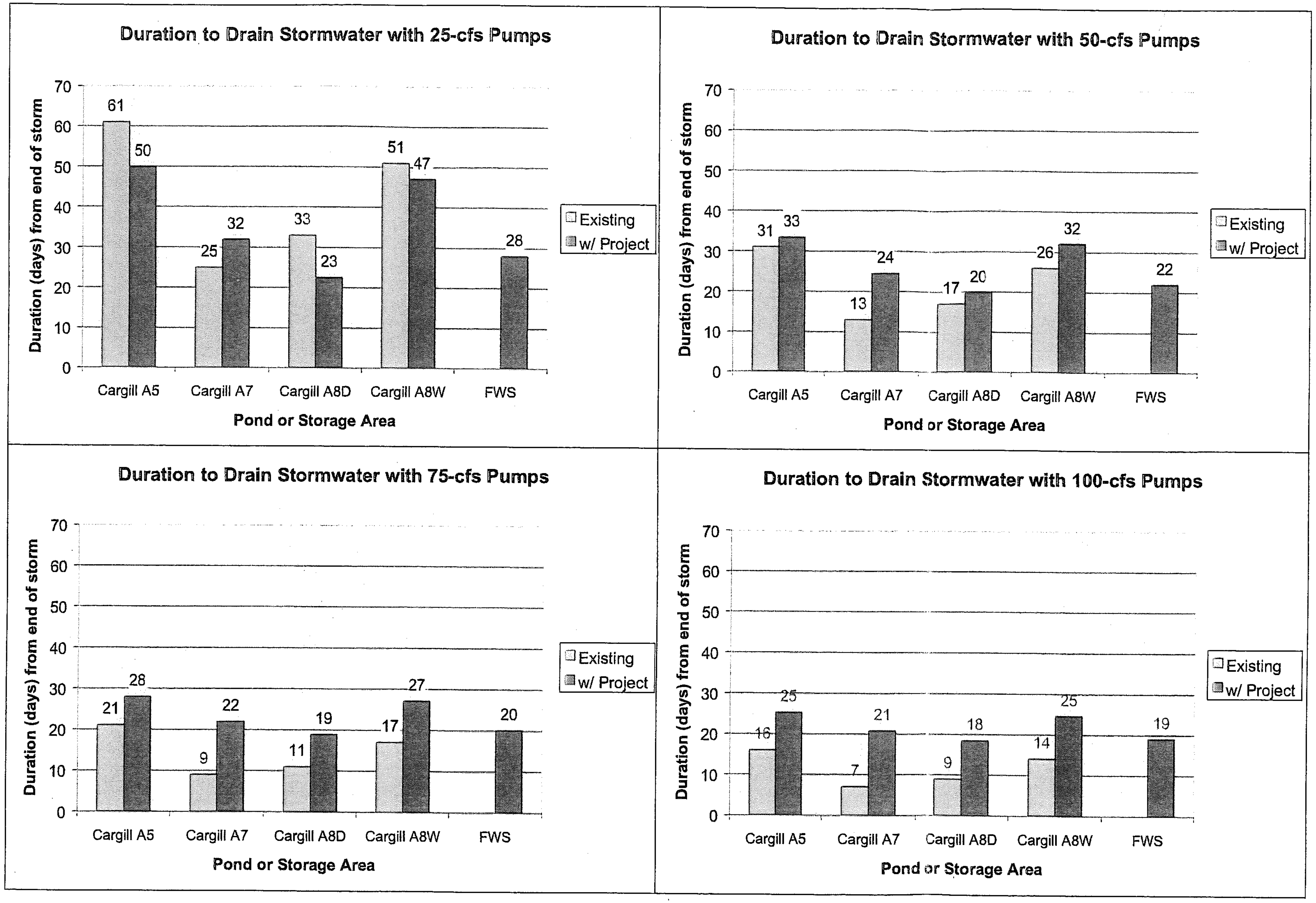


LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT

FIGURE 8

CARGILL POND A8W INTERIOR LEVEE MODIFICATIONS
SUPPLEMENTAL BAYLANDS HYDRAULIC ASSESSMENT

DECEMBER 2001



RESULTS IN THIS FIGURE COMPARE TWO HYDRAULIC CONDITIONS:

Existing Conditions:
- 14,000 cfs in Guadalupe River at UPRR;
- Design Storm occurs in early January;
- No antecedent storm effects (no prior pond flooding);
- Relying upon evaporation only will take about
- two years to get back to pre-storm elevations;
- Pumping could be added to reduce the duration of flooding in the ponds.

With LGR, Baylands Mitigation and no Stormwater Pumping into LGR:
- 17,000 cfs in Guadalupe River at UPRR;
- Design Storm occurs in early January;
- No antecedent storm effects (no prior pond flooding);
- No LGR stormwater pumping included in volume reaching Alviso Slough;
- Gravity drainage in baylands consists of one 8-foot diameter conduit with flap gate (one-way flow) for each pond A5, A7, A8W and A8D, and two 8-ft. dia. conduits for the USFWS Refuge (A6); all conduit inverts set at invert elevation for A8D and FWS Refuge, and pre-storm salt pond water surface elevations for A5, A7, and A8W.
- Gravity drainage alone, without subsequent pumping extends the duration period in A5, A7, A8W, A8D and the Refuge to more than a year.

APPROXIMATE STORM VOLUME IN EACH POND TO BE DRAINED**

Pond No.:	Existing Conditions:		With Lower Guadalupe River Project:	
Cargill A5	2,980	AF	3,605	AF
Cargill A7	1,235	AF	1,515	AF
Cargill A8D	860	AF	1,070	AF
Cargill A8W	3,175	AF	3,445	AF
FWS Refuge (A6)	0	AF	2,950	AF

** Volume includes mean monthly precipitation.

LEGEND:

"Existing"	Present-day conditions (e.g.-no baylands improvements) and assuming 14000 cfs can get to UPRR trestle at Alviso, California.
"With-Project"	Lower Guadalupe River Project completed to deliver 17000 cfs to UPRR trestle at Alviso, California, with no additional flow in LGR from local stormwater pumping.
"Duration"	The time necessary to draw pond flood stages back down toward pre-storm levels.

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LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT

nhc

FIGURE 9

APPROXIMATE VOLUME AND DURATION OF FLOODING IN SALT PONDS A5-A8
SUPPLEMENTAL BAYLANDS HYDRAULIC ASSESSMENT

19 DECEMBER 2001

COPY

Transmittal

northwest hydraulic consultants
3950 industrial boulevard, suite 100c
west sacramento, ca 95691
(916) 371-7400
(916) 371-7475 (fax)

Date: 7 December 2002 Project: A2248/A2248A
To: Steve Centerwall
Company/Agency: Jones & Stokes
From: Loren Murray, nhc
Subject: LGRFPP – Supplemental Baylands Hydraulic Analysis, Follow-up information requested during 10 December 2001 Meeting with Cargill.

Steve –

David Von Rueden asked me to provide you with a hardcopy of the most recent baylands reconnaissance analysis. Enclosed is the most recent memorandum of supplemental hydraulic analyses for the baylands area of the Lower Guadalupe River Flood Protection Project.

Also attached are Alviso Slough water surface profiles resulting from some sensitivity analysis of the overflow "weir" location with respect to LGR Design flows. The conceptual weir size for LGR design conditions that results in a downstream water surface profile similar to the pre-project (existing-today's) conditions is a weir of approximately 1000 feet in length, and having 3 stepped crest elevations. According to the reconnaissance-level modeling, this improved weir condition results in up to an additional 2 feet of floodwater going into Cargill ponds A5, A7, A8(W and D). The results are provisional, and are not acceptable for design purposes.

If you have any questions, please do not hesitate to give me a call.

Sincerely,
northwest hydraulic consultants, inc.

Loren A. Murray, P.E.

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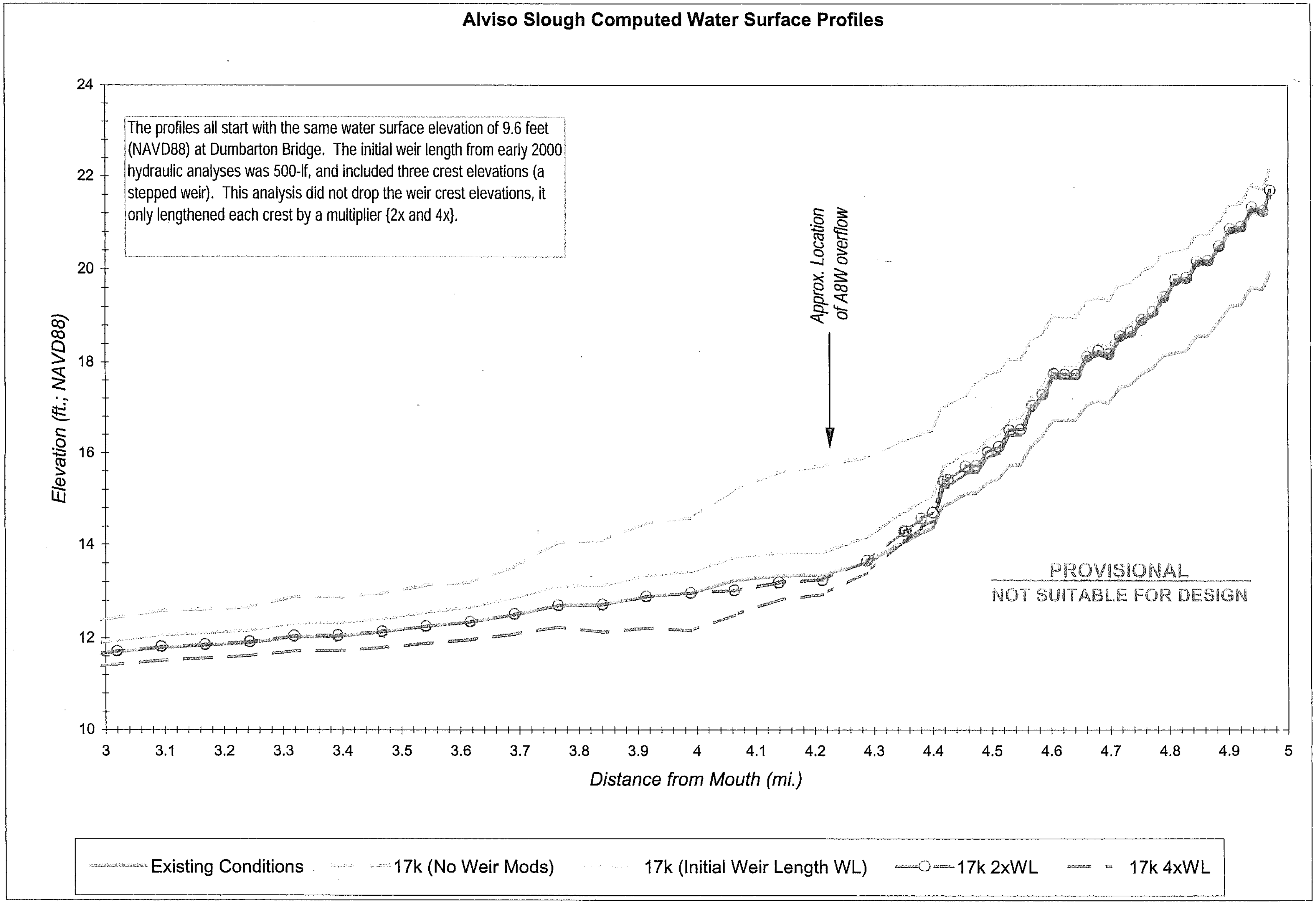
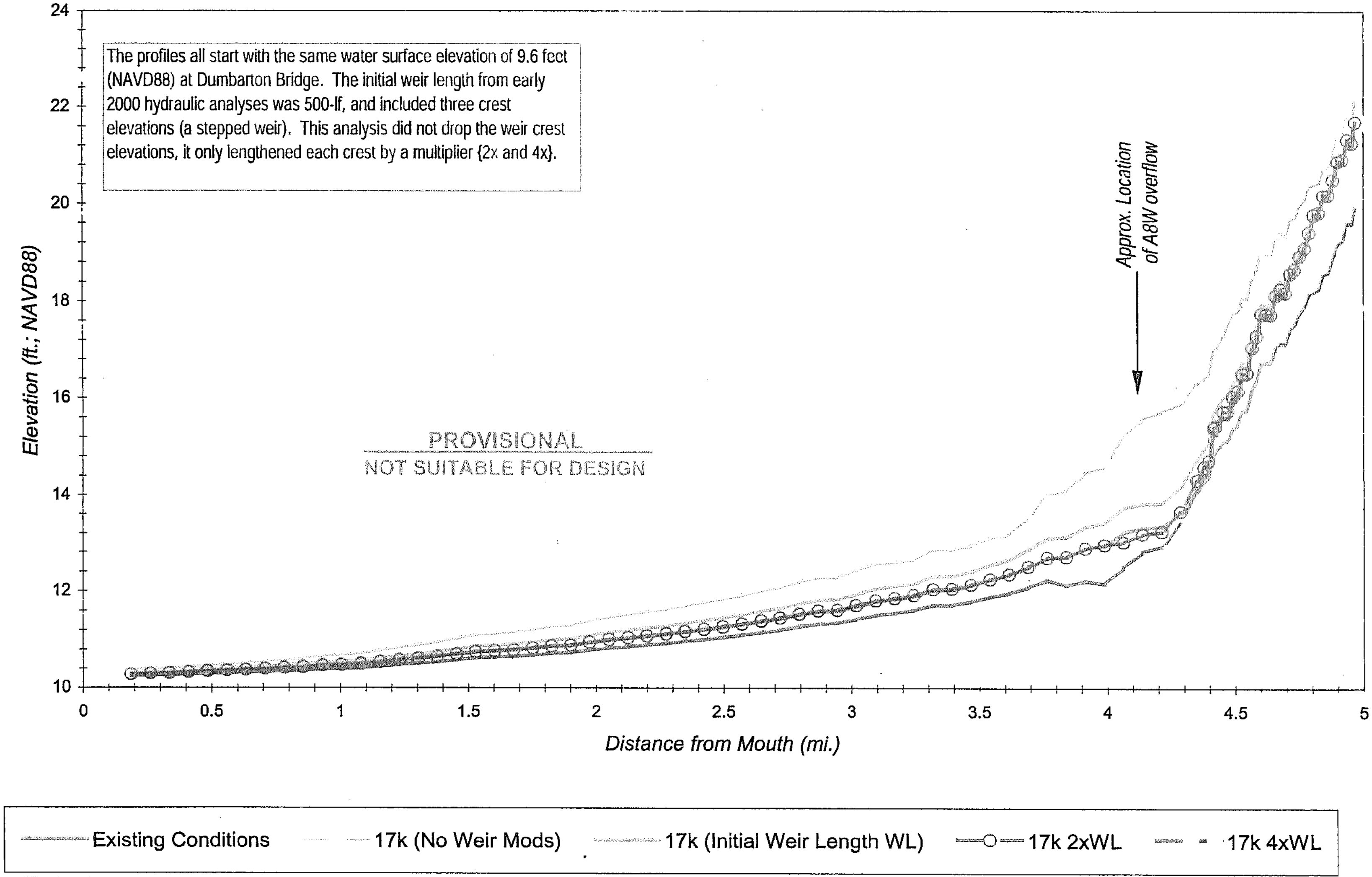

Alviso Slough Computed Water Surface Profiles
The profiles all start with the same water surface elevation of 9.6 feet (NAVD88) at Dumbarton Bridge. The initial weir length from early 2000 hydraulic analyses was 500-lf, and included three crest elevations (a stepped weir). This analysis did not drop the weir crest elevations, it only lengthened each crest by a multiplier {2x and 4x}.
Approx. Location of A8W overflow
PROVISIONAL
NOT SUITABLE FOR DESIGN
Elevation (ft., NAVD88)
24
22
20
18
16
14
12
10
3
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4
4.1
4.2
4.3
4.4
4.5
4.6
4.7
4.8
4.9
5
Distance from Mouth (mi.)
Existing Conditions
17k (No Weir Mods)
17k (Initial Weir Length WL)
17k 2xWL
17k 4xWL

Alviso Slough Computed Water Surface Profiles



The profiles all start with the same water surface elevation of 9.6 feet (NAVD88) at Dumbarton Bridge. The initial weir length from early 2000 hydraulic analyses was 500-lf, and included three crest elevations (a stepped weir). This analysis did not drop the weir crest elevations, it only lengthened each crest by a multiplier {2x and 4x}.

Memorandum

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(916) 371-7475 (fax)

Date:	11/13/01	Project:	50198
To:	David Von Rueden		
Company/Agency:	CH2M Hill		
Cc:	Jeff Johnson, NHC		
From:	Loren Murray and Robert MacArthur		
Subject:	LGRFPP – Preliminary Hydraulic Assessment of the Effects of Raising the Levees Around Cargill Pond A8W to Isolate it from Adjacent Ponds.		

This analysis computed the changes in water surface elevation that may occur if the levees around Pond A8W were raised in order to isolate it from ponds A8D, A7 and A5. The goal was to see if any appreciable flood protection benefits could be gained by temporarily storing more water into Pond A8W during the design event (17,000 cfs).

Three hydraulic conditions were evaluated and compared:

- Existing conditions today (no baylands improvements) with the 14,000 cfs event on LGR at Gold St.;
- Existing conditions today (no baylands improvements) with the 17,000 cfs event on LGR at Gold St.;
- Raised interior pond levees between A8W and A8D and between A8W and A7, with the 17,000 cfs event on LGR at Gold St.

Other hydraulic conditions or criteria included:

- No other baylands improvements (no engineered weir, Alviso Marina Levee, pond gravity drains, or pumping);
- The Cargill levees were raised to an elevation equivalent to adjoining Alviso/Guadalupe Slough levee elevations minus 3 feet (for safety purposes and to allow excess water to drain into adjoining ponds once the storage capacity of Pond A8W is exceeded);
- The 10-year design tide in the South Bay;
- Design events on all other hydraulic boundaries (Guadalupe Slough tributaries; Coyote Creek);

- Levees along both Alviso Slough and Guadalupe Slough were not modified; present top of levee profile data is assumed to be accurate;
- Floodwaters were excluded from entering the US FWS Refuge (Pond A6).

Following is a summary of results from the above modeling activities comparing 17,000 cfs and the leveed A8W (LA8W) scenario versus 17,000 cfs and the "no baylands improvements" (NBI) scenario:

- ☐ The depth of inundation increased in Pond A8W for the LA8W scenario versus the NBI scenario. Depths of ponding in A8W increased between 2 and 4 feet for a period of approximately 12 hours during the rising limb of the hydrograph and ultimately resulted in 0.75 to 0.5 feet higher stages in Pond A8W after the event.
- ☐ The depth of inundation increased in Pond A8D between 2 and 4 feet for a period of approximately 8 hours during the rising limb of the hydrograph and ultimately resulted in approximately 0.8 feet higher stages in Pond A8D after the event.
- ☐ The ultimate depth of inundation decreased in Ponds A7 and A5 by approximately 0.5 feet for the LA8W scenario versus the NBI scenario;
- ☐ No significant increase in stage or flow is observed in Alviso Slough downstream of the A8W overtopping location;
- ☐ Flood flows entering A8D from A8W were only lagged for about two hours with the interior levees in-place (i.e. – spillage from A8W to A8D commenced two hours later under the leveed scenario);
- ☐ Pond A8D actually started to receive floodwaters from Guadalupe Slough (due to slight levee overtopping from Guad Slough) prior to commencement of flooding by A8W overflows for the LA8W scenario (previous analyses showed commencement of flooding to A8D at about the same time from A8W and Guadalupe Slough);
- ☐ Due to the higher levee between A8D and A8W under the LA8W scenario, Pond A8D does not drain back through or into A8W as much as it does without the raised levees, thus A8D retains a greater volume at a greater depth (+ 0.8 feet) when pond A8W is leveed.

Based on these results, nhc's concludes that raising the levees around pond A8W does not result in any appreciable hydraulic or flood protection benefits to the Cargill ponds. Some areas are impacted more during the 17,000 cfs event if pond A8W is leveed whereas other areas are impacted slightly less. The specific location of environmental interest, Pond A8D, is impacted more under the LA8W scenario.

FILE
50198
CORRESP.

Loren Murray
10/29/2001 02:41 PM

To: drueden@ch2m.com, "Gomez, Erika/SJC" <egomez@CH2M.com>
cc: Jeff Johnson@NHC, Robert MacArthur@NHC
Subject: LGRFPP: Preliminary Findings of Alviso Slough Levee Modifications

David -

Attached please find the preliminary results of the baylands modeling results associated with five different Alviso Slough levee re-configurations. They are:

Alt 1: Raise Alviso Slough west levee from Gold St. to the Bay excluding the A8W overflow weir.

Baseline conditions everywhere else; 17kcfs design event on LGR; 10-yr tide; all other inflows at 1 percent events.

Alt 2: Raise both west and east Alviso Slough levees (including Co. Marina) excluding the A8W overflow weir; other conditions same as Alt 1.

Alt 3a: Baseline conditions everywhere; raising the existing A8W overflow weir by 1.0 feet.

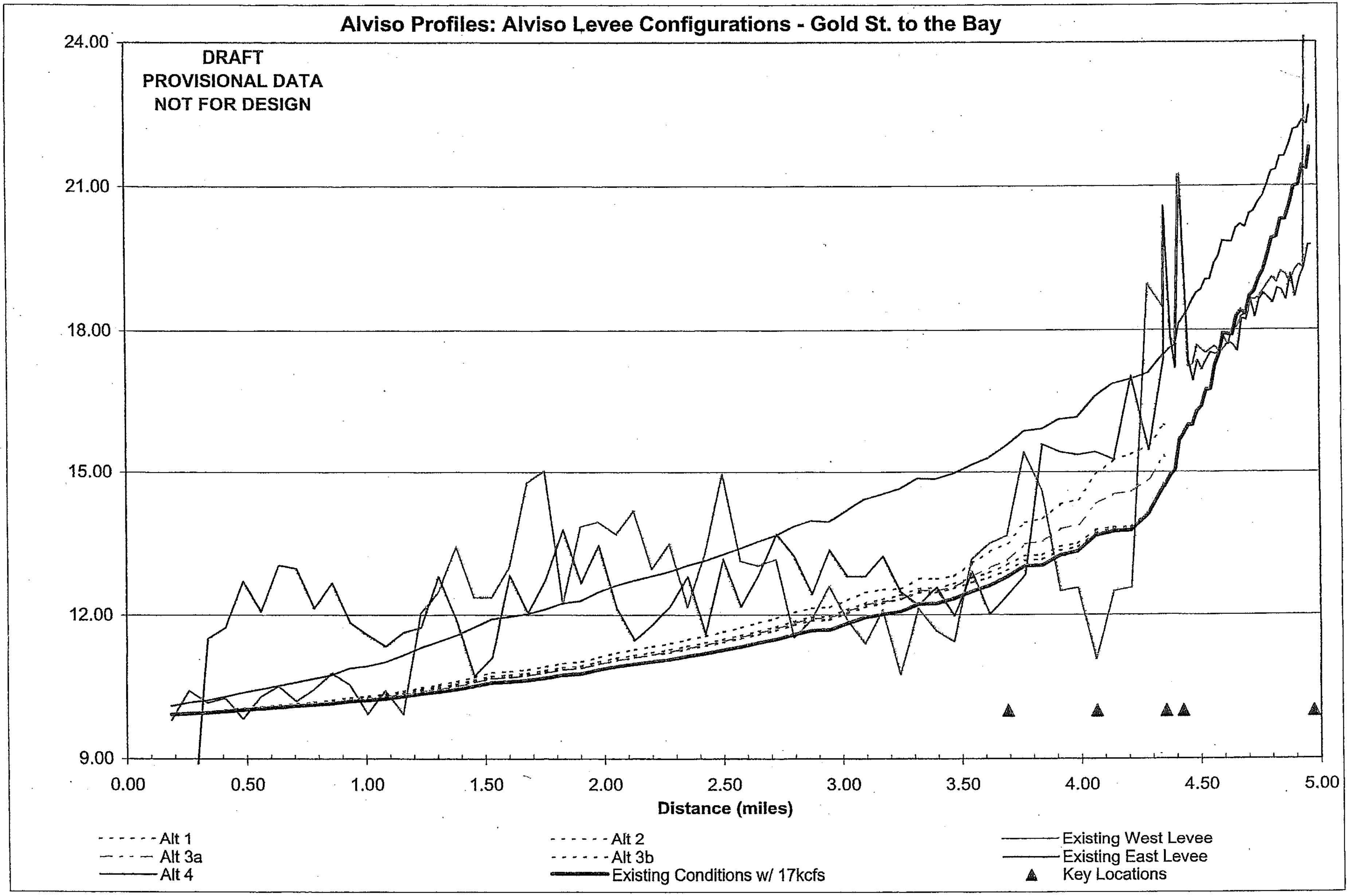
Alt 3b: Baseline conditions everywhere; raising the existing A8W overflow weir by 3.0 feet.

Alt 4: Raising both west and east Alviso Slough levees from Gold St. to the Bay;
NO overflows allowed out of slough anywhere from Gold St. downstream.

AlvisoProfiles.PDF

Hope this is helpful. /lm/

Loren A. Murray, P.E.
Northwest Hydraulic Consultants, Inc.
Phone: (916) 371-7400 ext 104
Fax: (916) 371-7475
Email: lmurray@nhc-sac.com

Alviso Profiles: Alviso Levee Configurations - Gold St. to the Bay
DRAFT
PROVISIONAL DATA
NOT FOR DESIGN
24.00
21.00
18.00
15.00
12.00
9.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
5.00
Distance (miles)
Alt 1
Alt 3a
Alt 4
Alt 2
Alt 3b
Existing Conditions w/ 17kcfs
Existing West Levee
Existing East Levee
Key Locations

Loren Murray
07/11/2001 09:03 PM

To: drueden@ch2m.com
cc: stevec@jsanet.com
Subject: LGRFPP - Baylands Revision 6 Flood Volumes and Evaporation Durations.

Gentlemen:

Attached are the revised results ("DRAFT") of the duration analysis for a) existing conditions and b) with-LGR excluding baylands mitigation.
Also provided are flood volumes ("DRAFT") for the different storage cells.

The data shouldn't change, but the format, presentation and/or comments on these figures are subject to minor refinements.

I will get started on the "latest" pumping scenario in place of gravity drains for the With-LGR Project including Mitigation Comps. I'm assuming that the Alviso Marina levee component remains, and the engineered overflow weir also remains; we're just replacing the gravity drains with 100cfs pumps. David, as a clarification, we're not attempting to size pumps or motors, just assuming that apparatus delivers 100cfs per outlet at the discharge end.

Please call me should you feel compelled to discuss this stuff further.

Rev6-Pre-Proj Evac Dur.PDF   Rev6-Post-Proj Evac Dur.PDF   Rev6PondImpacts.pdf

Loren

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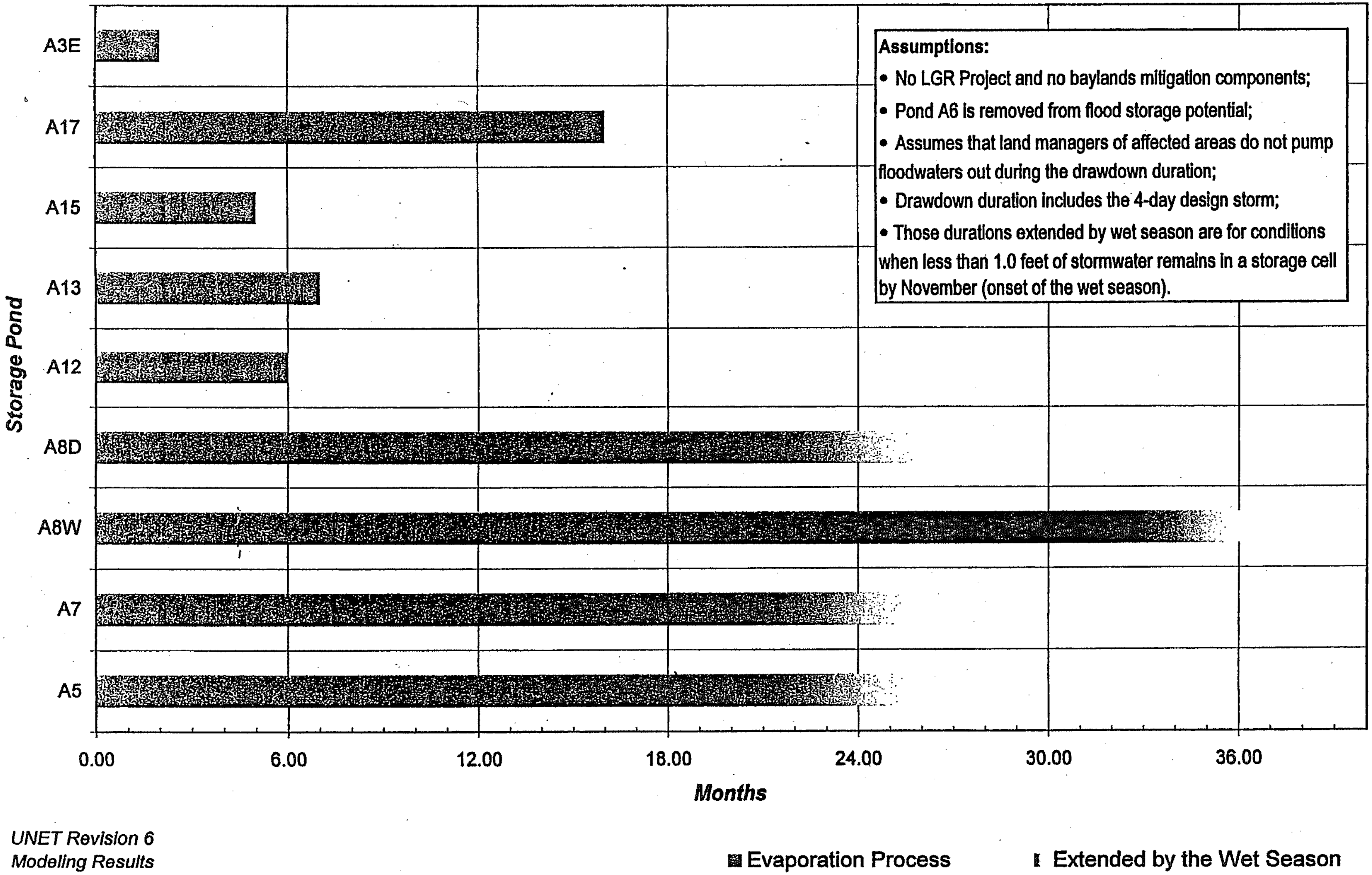
C:\Projects\50198\calcs\[Rev6-Pre-Proj Evac Dur.xls]Figures Tab

July '01

Existing Conditions (14,000 cfs on LGR) Drawdown Duration



Assumptions:

- No LGR Project and no baylands mitigation components;
- Pond A6 is removed from flood storage potential;
- Assumes that land managers of affected areas do not pump floodwaters out during the drawdown duration;
- Drawdown duration includes the 4-day design storm;
- Those durations extended by wet season are for conditions when less than 1.0 feet of stormwater remains in a storage cell by November (onset of the wet season).

UNET Revision 6
Modeling Results

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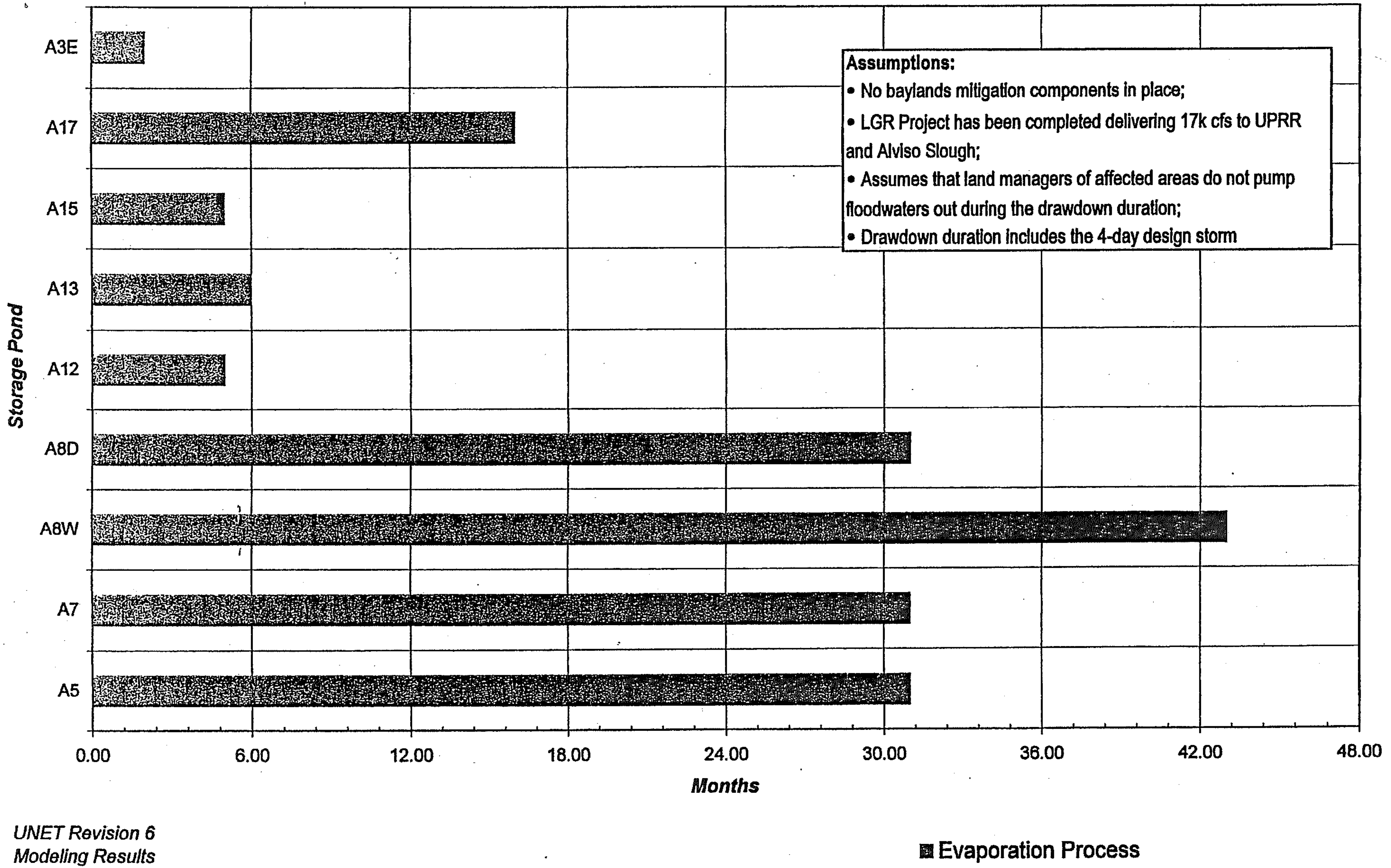
PRE-PROJECT BAYLANDS EVACUATION DURATION OF PONDS
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE

July 2001

C:\Projects\50198\calcs\[Rev6-Pre-Proj Evac Dur.xls]Figures Tab July '01

With-LGR Project (17,000 cfs on LGR) Drawdown Duration



Assumptions:

- No baylands mitigation components in place;
- LGR Project has been completed delivering 17k cfs to UPRR and Alviso Slough;
- Assumes that land managers of affected areas do not pump floodwaters out during the drawdown duration;
- Drawdown duration includes the 4-day design storm

UNET Revision 6
Modeling Results

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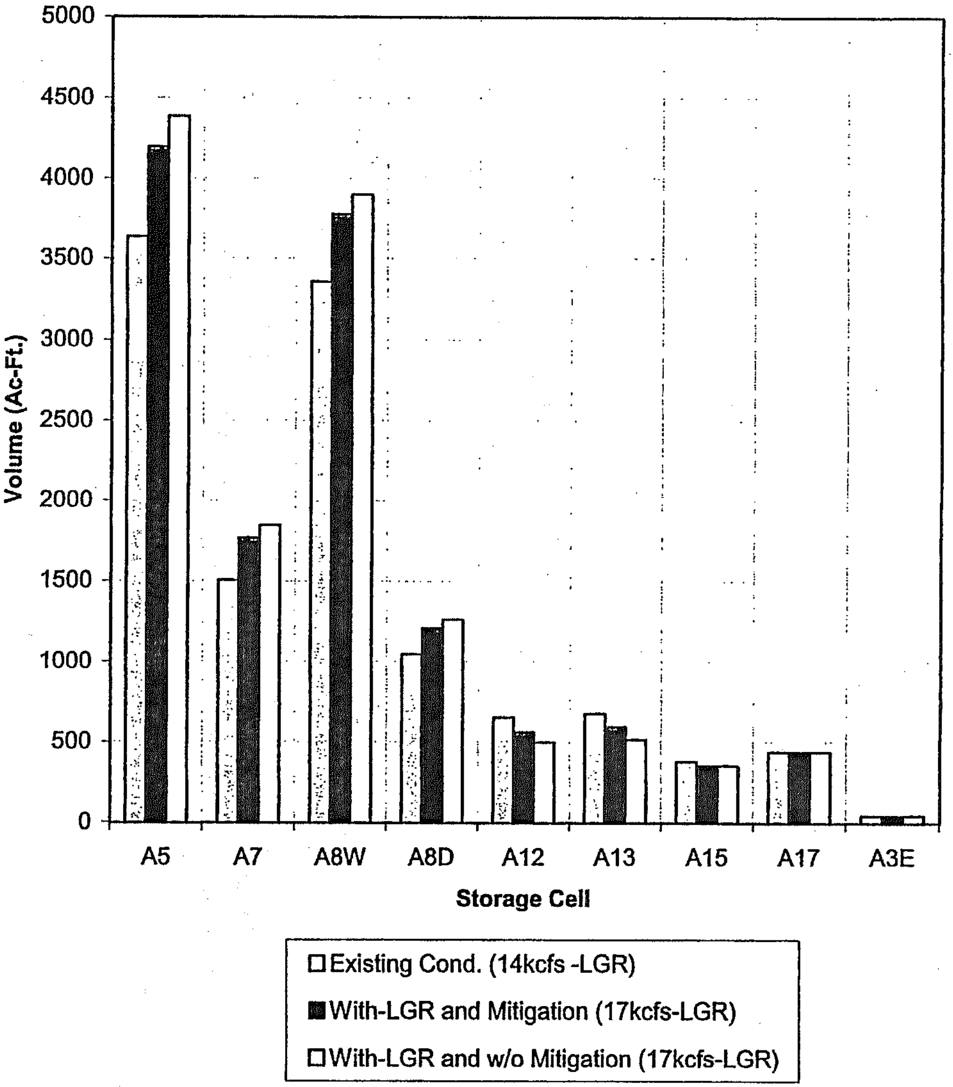
POST-LGR PROJECT BAYLANDS EVACUATION DURATION OF PONDS
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE
July 2001

C:\Projects\50198\calcs\[Rev6PondImpacts.xls]Figure

	VOLUMES (AF)		
Inundated Site	Existing Cond. (14kcfs -LGR)	With-LGR and Mitigation (17kcfs-LGR)	With-LGR and w/o Mitigation (17kcfs-LGR)
A5	3,635	4,199	4,387
FWS	-	-	-
A7	1,507	1,767	1,845
A8W	3,360	3,775	3,899
A8D	1,051	1,214	1,268
A12	653	560	498
A13	676	594	513
A15	380	355	355
A17	440	440	440
A3E	45	45	45
TOTAL:	**11,746**	**12,948**	**13,250**

- Maximum flood volume from 4-day design storm.
- Assumes all levees remain intact during entire storm duration.
- FWS Refuge (Pond A6) was not utilized for flood storage.
- With-LGR Project and Mitigation Components in-place (Col 2) excludes volumes returned to Alviso and Guadalupe Sloughs through the multiple gravity drainage culverts during the 4-day design event.



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4-DAY DESIGN EVENT FLOOD VOLUMES
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE XX

JULY 2001

Technical Memorandum

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(916) 371-7475 (fax)

Date:	July 5, 2001	Project:	A2248/A2248a
To:	David Von Rueden, CH2M Hill Dennis Cheong, SCVWD		
Cc:	Jeff Johnson, NHC		
From:	Loren Murray and Robert MacArthur, NHC		
Subject:	Lower Guadalupe River Flood Protection Project – Supplemental Baylands Analysis in Support of Draft EIR and Engineers, Report, nhc 50198.		

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1. Objective

The purpose of this hydraulic assignment is to make District-requested refinements to the baylands UNET model (Revision 6) for both the "existing" and "with-LGR project" conditions. The refinements affect the routing and storage of water in the Rincon De Los Esteros (RDLE) region south of Alviso and New Chicago Marsh (NCM), and the routing and storage performance of the New Chicago Marsh Canal (NCMC). Lastly, this analysis incorporates recent modifications made to the USFWS Knapp Refuge (formerly Cargill Pond A6) property removing it from temporary flood storage. The results contained herein are still at a reconnaissance level and can be used to understand likely flood-related problems within the baylands study area, but are not suitable for design purposes.

2. Results

The following results were obtained from this analysis, and are provided in comparison to previously reported flood related impacts for the baylands study area. Table 1 shows approximate inundation depths for various baylands components, and is provided on the next page. Following is a summary of results observed from the analysis:

- With the removal of Pond A6, Ponds A5, A7, A8W and A8D are flooded to a greater depth under the "with-LGR project" conditions when compared to results of previous analyses. Pond A6 does not affect "existing" conditions since A6 is not expected to flood under "existing" hydraulic conditions;
- Results indicate that RDLE is flooded to a slightly greater depth under both "existing" and "with-LGR project" conditions when compared to previous reporting. Please note a range of computed depths are reported for RDLE (Table 1) that reflect different depths of flow occurring throughout the RDLE routing reach;
- Results indicate a slight reduction in inundation depths to Alviso under both "existing" and "with-LGR project" conditions when compared to previous reporting;

- Results indicate an increase in flooding to NCM under "existing" conditions, and a small decrease in inundation under "with-LGR project" conditions when compared to previous reporting. These same results show how sensitive flood depths in Alviso are if other sources of flooding affect water surface elevations in NCM;
- Model revisions that now route flows from Coyote Creek through NCMC result in greater inundation depths in Ponds A17, A15, A13, and A12 for both "existing" and "with-LGR project" conditions when compared to previous results;
- Results indicate increased flooding to Ponds A5, A7, A8W and A8D under both "existing" and "with-LGR project" conditions when compared to previous results primarily due to the removal of pond A6 for storage of flood water;
- The "with-LGR project" duration to drain Ponds A5-A8 by gravity (See Table 2) increases for A5, A7 and A8D due to both increased inundation depths as a result of removing Pond A6, and the removal of two gravity drains which were located in Pond A6 under previous analyses;
- The results indicate that the "with-LGR project" duration to drain Pond A8W by gravity decreases when compared to previous results. As estimated in the April 2001 results, the model simulation is run continuously for a 2 month period, and then the slope of the drawdown curve is estimated from the last 10-days of simulation (refer to procedure described in the 30 April 2001 Memo). A linear drawdown is projected from the end of the 2 month simulation until it intercepts the pre-storm starting elevation in the pond. Realistically, the drawdown will not continue linearly, but will slow down and flatten out as the A8W inundation depth decreases, thus resulting in a longer duration than this method predicts. **nhc** did not perform a simulation greater than the 2-month period. Taking the average "last 10-day drawdown slope" of the other interior ponds (A5, A7 and A8D) and projecting a linear intercept based on this average slope yields a drawdown duration of 9 months. Therefore, we have reported a range of drawdown duration for Pond A8W in Table 2 (6.8 to 9 month);

The following table shows computed design event inundation depths for the Revision #6 UNET model. The three columns of data represent: (A) "existing" conditions, (B) "with-LGR project" conditions including baylands mitigation components[1], and (C) "with-LGR project" conditions without baylands mitigation components. Previously reported results (Apr 2001) are shown in parentheses.

TABLE 1
INUNDATION DEPTHS (IN FEET) FOR THE 4-DAY DESIGN STORM SIMULATION
(All elevations are ±0.5 ft.)

Baylands Study Component:	Existing (Present-day) Conditions	With-LGR Project and Baylands Mitigation[1]	With-LGR Project but not Baylands Mitigation
Rincon De Los Esteros	3.4 – 6.2 (2.8)	1.9 – 3.9 (0.3)	1.9 – 3.8
Alviso, California	7.2 (8.8)	4.0 (6.5)	4.3
New Chicago Marsh	7.2 (5.3)	3.9 (4.7)	4.3
Cargill Pond A5	5.8 (4.5)	6.7 (5.8)	7.0

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[1] Baylands mitigation components include i) Alviso Slough levee improvements near the County Marina to remove the LGR flood threat to Alviso, ii) an engineered overflow weir across from Alviso allowing floodwaters to more efficiently spill into Pond A8W, iii) one-way gravity drain outlets to release stored floodwaters from Ponds A5, A7, A8W and A8D after the major flood has past, and iv) the authority to direct floodwaters into Cargill properties (Ponds A5, A7, A8W and A8D).

USFWS Refuge (A6)	0.0 (0.0)	0.0 (5.4)	0.0
Cargill Pond A7	5.8 (4.6)	6.8 (5.9)	7.1
Cargill Pond A8W	8.1 (6.9)	9.1 (8.4)	9.4
Cargill Pond A8D	5.8 (4.5)	6.7 (6.0)	7.0
Cargill Pond A9	0.0 (0.0)	0.0 (0.0)	0.0
Cargill Pond A10	0.0 (0.0)	0.0 (0.0)	0.0
Cargill Pond A11	0.0 (0.0)	0.0 (0.0)	0.0
Cargill Pond A12	2.1 (0.0)	1.8 (0.1)	1.6
Cargill Pond A13	2.5 (0.0)	2.2 (0.0)	1.9
Cargill Pond A14	0.0 (0.0)	0.0 (0.0)	0.0
Cargill Pond A15	1.4 (0.0)	1.4 (0.0)	1.4
Cargill Pond A16	0.0 (0.0)	0.0 (0.0)	0.0
Cargill Pond A17	3.3 (0.0)	3.3 (0.0)	3.3
Cargill Pond A3E	0.1 (0.1)	0.1 (0.1)	0.1
Cargill Pond A3W	0.0 (0.0)	0.0 (0.0)	0.0

Table 2 shows the results of the long-duration drawdown of ponds A5, A7, A8W and A8D using one-way gravity drainage culverts (one for each of the four ponds). Refer to previous technical memorandum dated 27 February 2001 for the locations and dimensions of the one-way gravity drain culverts, and the 30 April 2001 memorandum for the method used to predict the full duration drawdown.

TABLE 2
DURATION (MONTHS) TO RETURN AREAS TO PRE-STORM CONDITIONS

Baylands Component:	Current Results* (Jul 01)	Previous Results (Apr 01)
Cargill Pond A5	3.7	3.5
USFWS Refuge (A6)	-n/a-	2.3
Cargill Pond A7	4.9	3.2
Cargill Pond A8W	6.8 – 9**	9.2
Cargill Pond A8D	4.4	2.6

* Duration estimates include the initial single 4-day storm event.
** This high-end duration estimate is based on using an average of the drawdown curve slope from Ponds A5, A7 and A8D to predict duration to intercept the pre-storm starting pond elevation.

3. Outstanding Issues

The following issues need further discussion and resolution in order to perform design activities and improve the reliability of a baylands-LGR mitigation project. The following is a summary of issues and concerns potentially affecting the hydraulic performance of the baylands mitigation components of the LGR:

- Although the flood threat to Pond A6 from Ponds A5 and A7 was removed during this assessment, the potential of A6 flooding from Alviso Sl., Guadalupe Sl., or Coyote Cr. levee overtopping may still exist. Lack of adequate levee profiles and channel geometry of the contiguous sloughs and Coyote Creek precludes performing hydraulic analyses sufficient to rule out these potential flood threats to the USFWS Refuge during a design event.

- The Cargill Ponds A9, A10 and A14 were introduced into Revision #6 of the UNET model but lack any reasonably accurate topographic data for these pond's perimeter levees. In addition, the interior levee (which separate one pond from another) elevations for these ponds as depicted in the UNET model are speculative. Potential flood impacts to these ponds are only very rough estimates until reasonably accurate geometry and topographic information is obtained and used in future analyses. Changes to the elevations of any of these levees could affect the present hydraulic results. **nhc** recommends that additional data collection take place to support and improve the results of future hydraulic analyses and design-levee studies.
- Under both the design event (4-day storm) analysis and the long-duration drawdown analysis, it is assumed that all levees remained intact during the entire event even at locations where overtopping occurs. Significant scouring and levee sloughing occurred to the Pond A8W-Alviso Slough levee during the few hours of continuous overtopping that occurred in the March 1995 event. Future hydraulic and geotechnical analyses should look at representative levee failure scenarios to quantify likelihood and magnitude of unforeseen impacts associated with catastrophic levee failures in the system as well as hydraulic impacts to system performance (ability to manage the remainder of the design storm during and after a failure has occurred).
- Lack of nested storm events analyses to identify the baylands system performance under these conditions is of concern when the LGR and baylands performance is dependent upon both flow routing and temporary storage of flood flows. Review of recent historical events in 1995 and 1998 indicate that storm nesting within a 2-3 month timeframe is a reasonable hydrologic expectation. Future hydraulic analyses should include simulation of nested storm events comparable to the recent historical events of 1995 and 1998.
- Effects of pumping vs. no pumping (and other unresolved EOP issues) wasn't assessed during this analysis. If LGR pumping has to occur (thus directing more discharge into the baylands area), additional mitigation may be required to compensate for greater peak flows, larger event volumes and additional impacts associated with this pumping. Future hydraulic analyses should evaluate possible pumping related impacts, if any, to the LGR and baylands flood control project.
- Neither this refinement analysis nor previous analyses have looked at the performance of the entire system (LGR and baylands components) for storm events greater than the design event. Future hydraulic analyses should address this hydraulic condition in order plan for emergency management activities that may be required during such an event.

4. Study Hydrology

The following is a description of the hydraulic boundary conditions used in this hydraulic analysis of the baylands using Revision #6 of the UNET model. The hydrologic boundary conditions for both existing and with-LGR Project conditions are presented below. Figures A through C depict the "existing" and "with-LGR project" hydrologic boundary conditions used in these analyses.

4.1 Existing Conditions – This represents our best estimates of the baylands conditions as they exist presently. Hydrologic boundary condition assumptions for this scenario include:

4.1.1 North First Street – Runoff from the North First Street corridor consists of flows that leave the Guadalupe River when maximum channel capacity is exceeded in the reach between Interstate 880 (I-880) and Highway 237 (Hwy237), and local interior runoff not pumped from City or Caltrans pump stations into the Lower Guadalupe River. The

District method[2] of computing storm drainage runoff for the 1 percent rainfall event was used to estimate the local interior runoff generated in the North First Street corridor between I-880 and Hwy237. North First street flows also include all Lower Guadalupe River flows in excess of 14,000 cfs (estimated maximum bank-full channel capacity) assumed to overtop between I-880 and Hwy237 and commingle with the local interior runoff.

4.1.2 Lower Guadalupe River – The design flow at I-880 is estimated to be the U.S. Army Corps of Engineers' 17,000 cfs peak flow hydrograph as has been used in previous analyses. By the time this hydrograph has reached Hwy237, it is assumed that all flows above 14,000 cfs have spilled out of the Guadalupe River into the North First Street corridor upstream of Hwy237.

4.1.3 Coyote Creek – The U.S. Army Corps of Engineers 1 percent event hydrograph from the published General Design Memorandum is used for the existing conditions storm hydrograph on Coyote Creek. This is the same event used for previous analyses. Its peak discharge has been lagged behind the LGR peak by 12 hours in accordance with District direction.

4.1.4 Guadalupe Slough – The hydrographs used on the tributaries to Guadalupe Slough are based on the shape of the Guadalupe River design hydrograph upstream of the Los Gatos Confluence, and the peak flowrate of the hydrographs are based on District-provided 1 percent event flowrates. This is the same approved boundary condition used in previous analyses.

4.1.5 Dumbarton Tide – As approved previously by the District, the 10-year tide[3] is used for the Dumbarton bridge hydrologic boundary condition. The peak of the 10-year tide coincides with the time of the peak discharge rate of the Lower Guadalupe River design hydrograph.

4.2 With-LGR Project Conditions – This represents the conditions expected with the LGR project in place, and previously identified mitigation components constructed in the baylands study area. The following hydrologic boundary conditions are used in the "With-LGR Project" UNET model:

4.2.1 North First Street – These are the same flow conditions described for the "existing" conditions excluding any overtopping flows from the LGR.

4.2.2 Lower Guadalupe River – The runoff at I-880 is estimated to be the U.S. Army Corps of Engineers 17,000 cfs peak flow hydrograph as has been used in previous analyses. This design hydrograph is contained by the LGR project and is conveyed without any losses past UPRR and into Alviso Slough.

4.2.3 Coyote Creek – There is no change for this hydrologic boundary condition; the same hydrology as the "existing" condition scenario applies.

---

[2] Refer to Memorandum dated 24 May 2001 regarding procedures followed in developing the N. First Street local runoff component.

[3] The 10-year tide is based on the U.S. Army Corps of Engineers publication, "San Francisco Bay Tide Stage vs. Frequency Study", October 1984.

4.2.4 Guadalupe Slough – There is no change for this hydrologic boundary condition; the same hydrology as the "existing" condition scenario applies.

4.2.5 Dumbarton Bridge – There is no change for this hydrologic boundary condition; the same 10-year tide condition as used in the "existing" condition scenario applies.

4.3 Long-Duration Simulations – The hydrologic boundary conditions for the "with-project" Pond A5-A8 gravity drain assessment were developed for a two-month model simulation.

4.3.1 Hydrographs – Hydrographs for the river boundaries were developed by taking the 4-day single-event hydrographs and dropping their residual base flows (at about hours 42-48) down to estimated base flows throughout the remainder of the two month period. No antecedent flooding or storm nesting was considered for the two-month simulation. Table 3 shows the estimated nominal or residual base flows for the boundary conditions that were used following the passage of the design event:

TABLE 3
BASE FLOWS USED IN LONG-DURATION UNET MODEL*
(Model Reach numbers in parentheses)

(1) North First St. to RDLE:	5 cfs	(7) San Tomas Aquinas Cr.:	50 cfs
(2) Coyote Creek:	200 cfs	(7) Calabazas Cr.:	50 cfs
(3) NCMC to NCM:	20 cfs	(7) Sunnyvale East Drain:	50 cfs
(5) Lower Guadalupe River:	50 cfs	(7) Sunnyvale West Drain:	50 cfs

* Needed for model stability over the two month simulation.

4.3.2 Dumbarton Tide Boundary – The long duration tidal boundary was developed by taking the estimated 10-year tide sequence for approximately the first two weeks and appending onto it historical tides for March and April 1995 at Dumbarton Bridge. The intent was to simulate reasonable effects of a storm event over a two-week period followed by historical tide conditions for this period of the year (March-April timeframe).

5. Hydraulic Analysis

The key refinements (Revision #6) to this UNET model were made to be able to route North First Street flow through RDLE, NCM and the NCM canal using UNET. The revised model depicts the RDLE and NCMC as routing reaches instead of storage cells. Figure D is a schematic of the revised UNET Model. This refinement required development of cross-section data for the two new reaches. The cross-section data for RDLE were derived from recent Alviso, California topography collected earlier this year and from USGS quadrangle mapping. Cross-section data for NCMC came from previous surveys by CH2M Hill, Kier & Wright, and Fremont Engineers. Both new routing reaches required pilot channels to stabilize the model and achieve successful simulations. The dimensions of the pilot channels are nominal, and do not affect results presented in this memorandum. Due to the level of accuracy of the data utilized in this UNET modeling, the estimated results reported herein are considered reconnaissance-level, and are not suitable for design purposes.

Encls (4 – Figures A-D)
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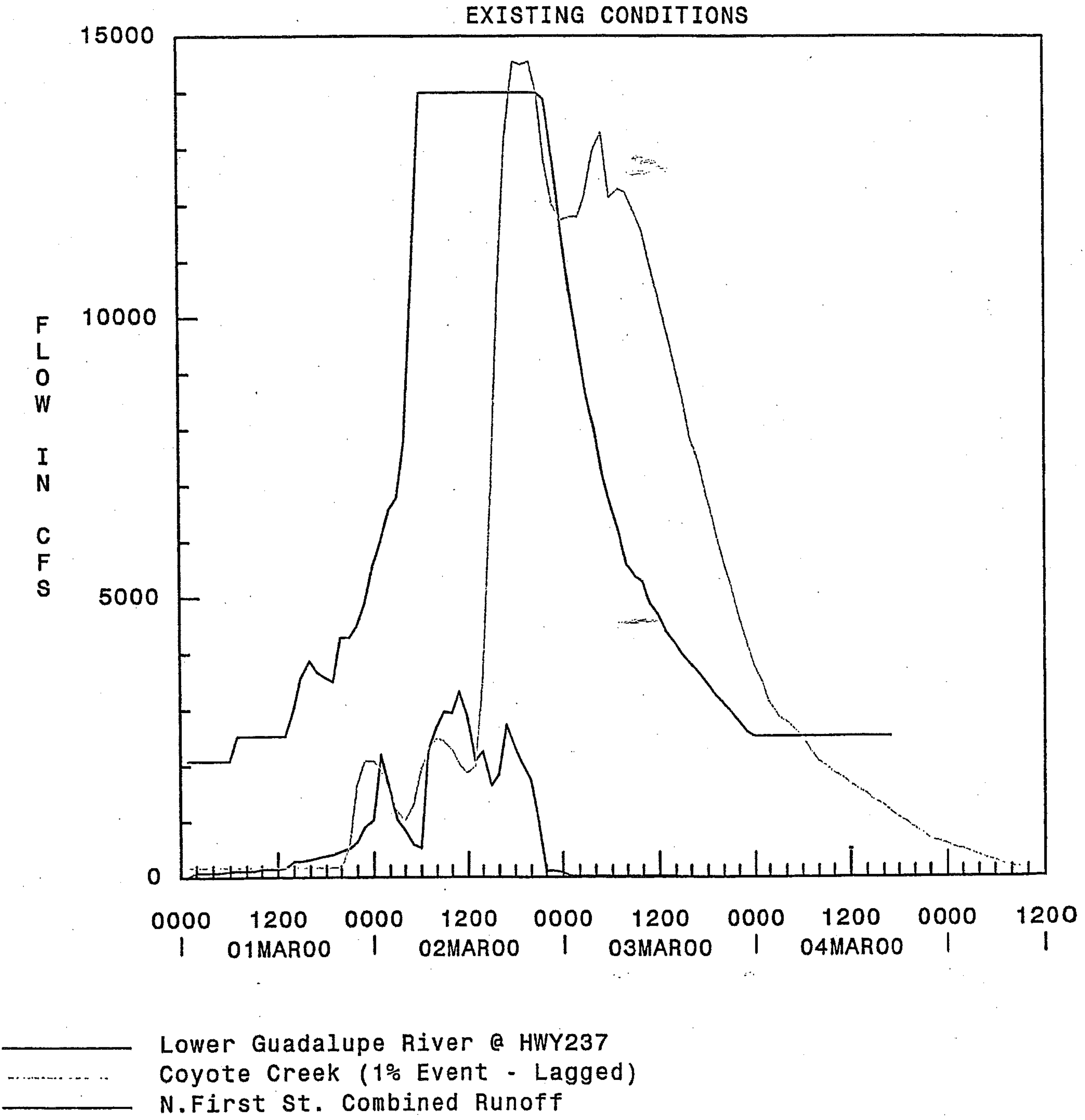
PROVISIONAL



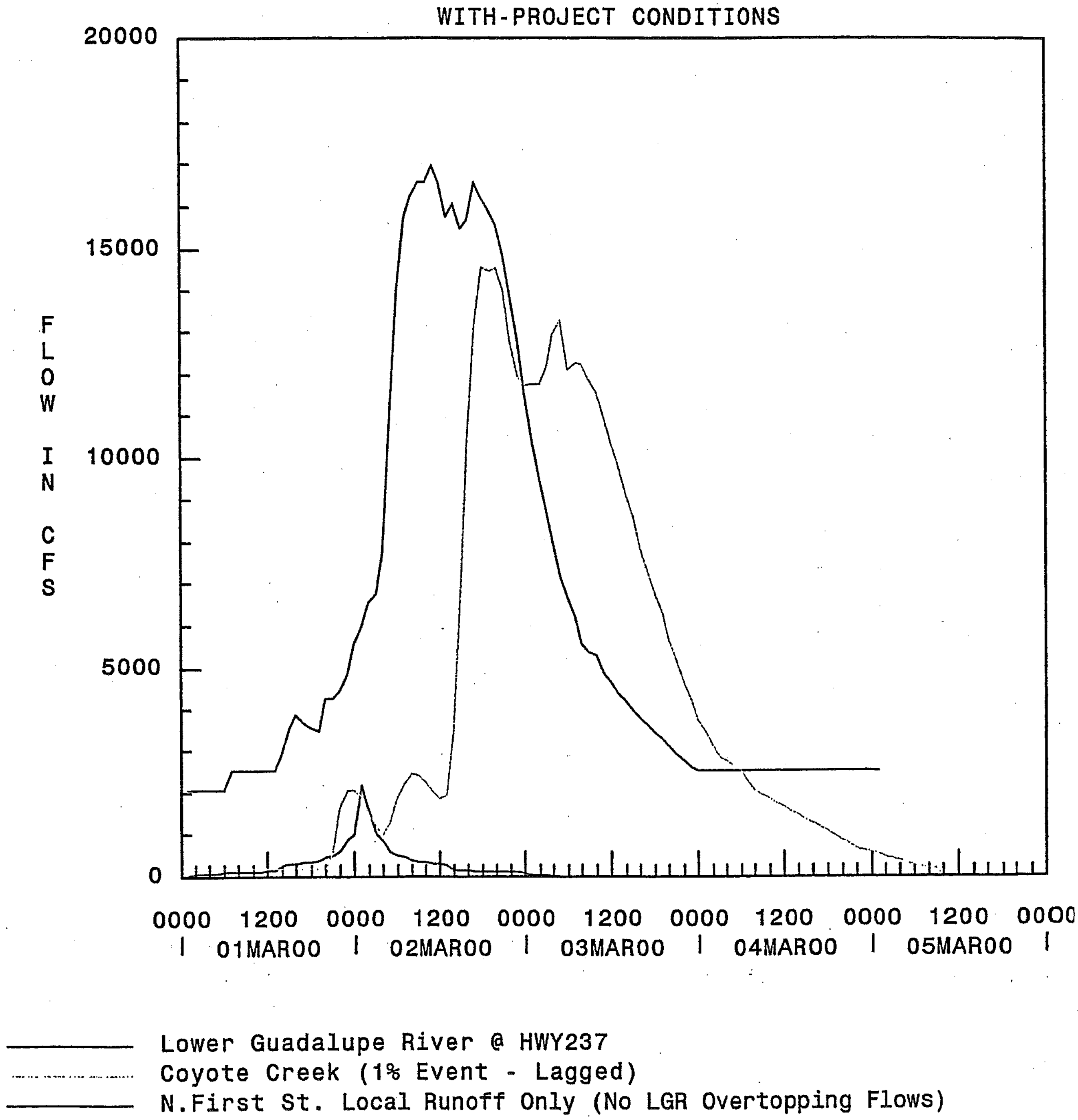
nhc

BAYLANDS EIR UNET MODELING
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT

JUNE 2001

UNET MODELING HYDRAULIC BOUNDARY CONDITIONS
FOR THE EXISTING CONDITIONS SCENARIO
FIGURE A

PROVISIONAL

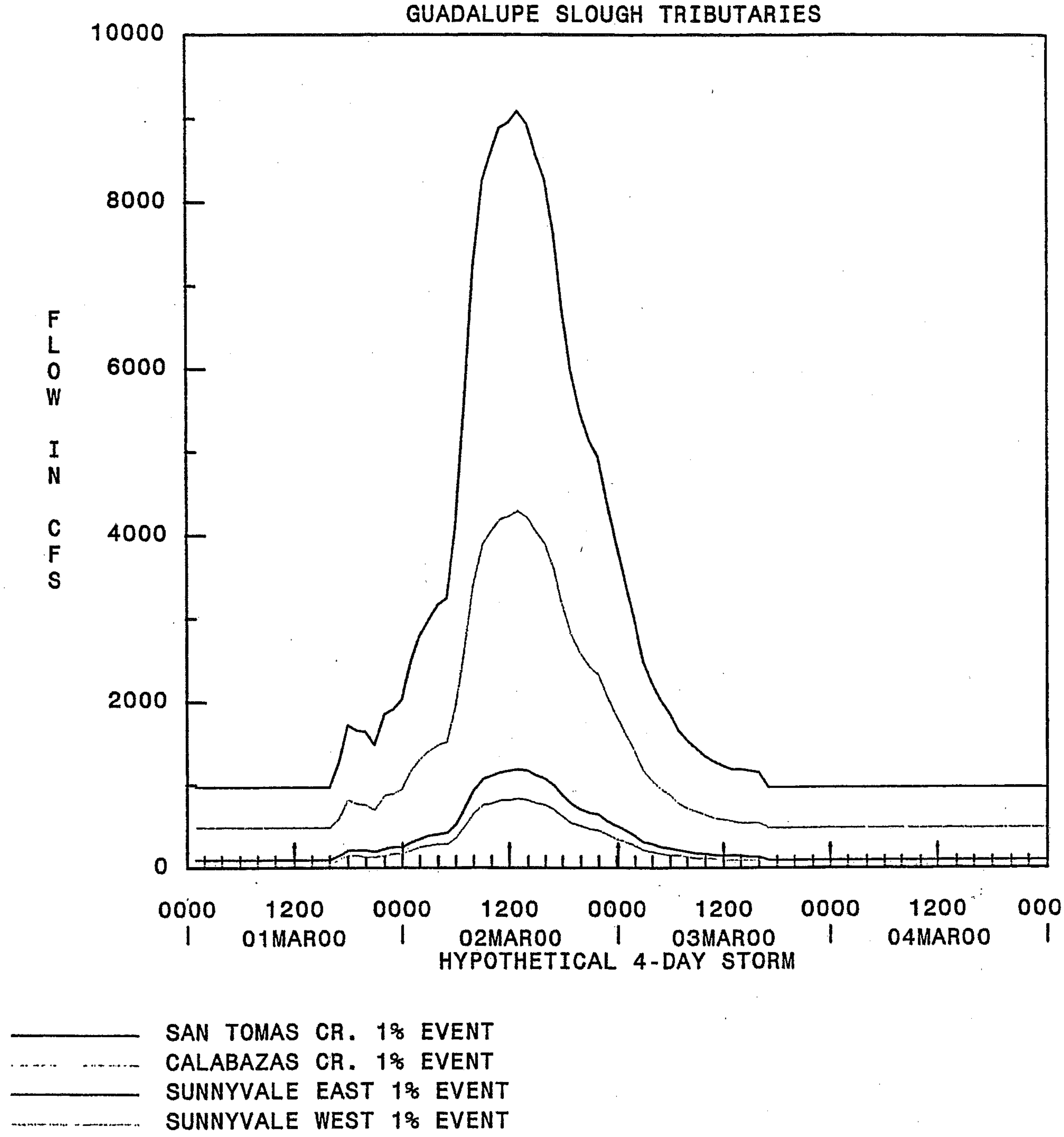


nhc

BAYLANDS EIR UNET MODELING
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT

JUNE 2001
UNET MODELING HYDRAULIC BOUNDARY CONDITIONS
FOR THE WITH-LGR PROJECT SCENARIO
FIGURE B

PROVISIONAL



JUNE 2001

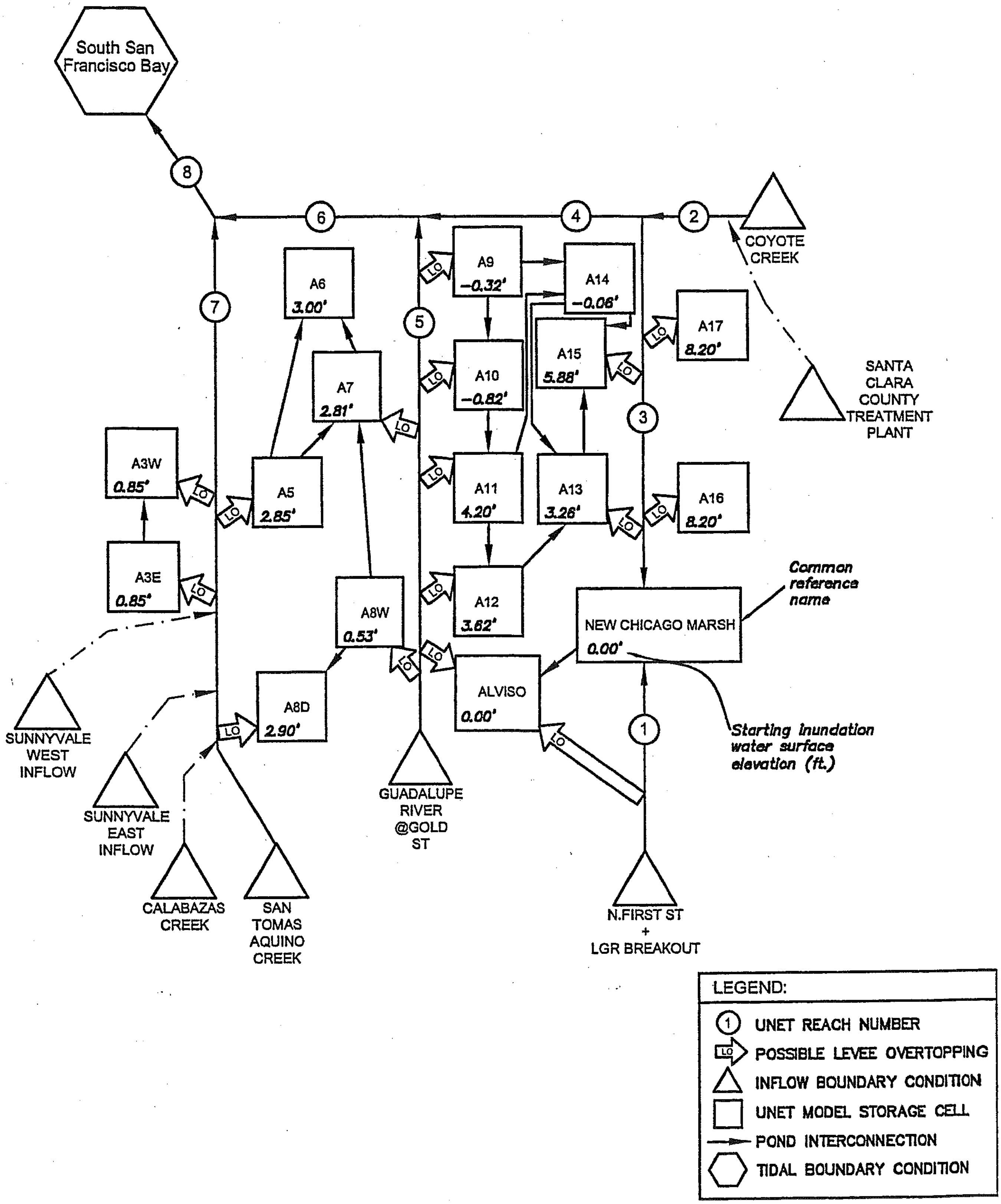
nhc

UNET MODELING HYDRAULIC BOUNDARY CONDITIONS
FOR BOTH THE EXISTING CONDITIONS AND WITH-LGR PROJECT SCENARIO

BAYLANDS EIR UNET MODELING
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT

FIGURE C

PROVISIONAL



Prepared for:
Santa Clara Valley Water District

nhc

BAYLANDS EIR UNET MODELING
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT

JUNE 2001
UNET MODEL LAYOUT SCHEMATIC
DISTRICT REVISION NO. 6
FIGURE D

Loren Murray
06/26/2001 10:54 AM

To: drueden@ch2m.com
cc: Jeff Johnson@NHC
Subject: LGRFPP: Early Reporting of Baylands EIR UNET Modeling Revision #6

FILE
50198 - CORRESP.

Transmittal Email Message

To:	David Von Rueden, CH2M Hill
Cc:	Jeff Johnson, NHC
Project:	Contract A2248/A2248a - Lower Guadalupe River Flood Protection Project; Baylands EIR UNET Modeling Results, nhc 50198.

David:

Attached for your use are two PDF files. The first is a table showing depths of inundation in the baylands study area as a result of the most recent modeling activities. The table shows values estimated by the model, the same values when considering a +/- half-foot confidence, and values reported previously in April 2001. The second file is just a figure showing the location of the baylands impact areas.

Rev6 Results.PDF Recon_Setting.PDF

As we discussed on the telephone yesterday afternoon, nhc is scheduled to complete the long-duration with-project conditions by Friday June 29, and the subsequent technical memo documenting all Revision 6 modeling assignments and results by Friday July 6.

If you have any questions, please call either Bob MacArthur or me at (916) 371-7400.

Sincerely,
northwest hydraulic consultants, inc.

/lm/

Loren A. Murray, P.E.
Northwest Hydraulic Consultants, Inc.
Phone: (916) 371-7400 ext 104
Fax: (916) 371-7475
Email: lmurray@nhc-sac.com

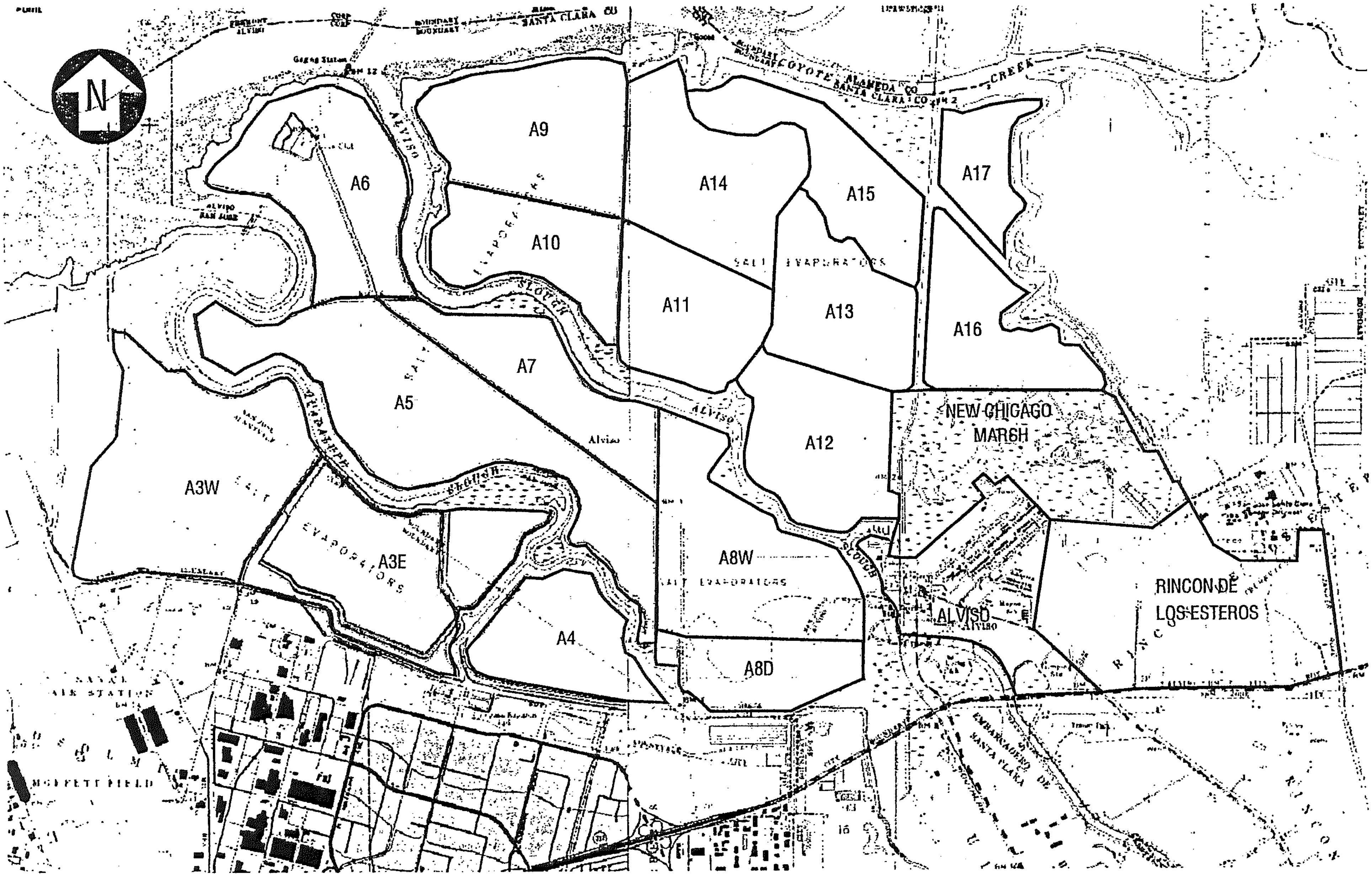
PROVISIONAL

Table 1
Design Event Ponding Depths in Baylands from UNET Modeling Revision #6
Baylands Inundation for Existing Conditions vs. With-LGR Project + Mitigation Components(A)

Study Area:	Estim. Starting Elev. (ft; NAVD88)	Revision #6 UNET Values: Depth (ft) ExCond	Depth (ft) w/ LGR Proj	Reasonable Estimates: Depths in Ft.; Δ = ±0.5 ft. ExCond	With-LGR Proj	*Previous (Apr 2001) Estimates: Computed UNET Depths (ft): ExCond*	*W/-LGR Proj(B)*
Rincon De Los Esteros	3.0	4.0	2.3	3.5 to 4.5	1.8 to 2.8	*2.8(C)*	*0.3(D)*
Alviso, California	0.0	7.1	4.0	6.6 to 7.6	3.5 to 4.5	*8.8(C)*	*6.5(D)*
New Chicago Marsh	0.0	7.1	3.6	6.6 to 7.6	3.1 to 4.1	*5.3(C)*	*4.7(D)*
Cargill A5	2.9	5.5	6.5	5 to 6	6 to 7	*4.5*	*5.8*
Cargill A6	3.0	0.0	0.0	0.0	0.0	--	*5.4*
Cargill A7	2.8	5.6	6.5	5.1 to 6.1	6 to 7	*4.6*	*5.9*
Cargill A8W	0.5	7.9	8.9	7.4 to 8.4	8.4 to 9.4	*6.9*	*8.4*
Cargill A8D	2.9	5.5	6.5	5 to 6	6 to 7	*4.5*	*6.0*
Cargill A11(E)	4.2	2.6	2.6	2.1 to 3.1	2.1 to 3.1	--	--
Cargill A12	3.6	1.3	1.4	0.8 to 1.8	0.9 to 1.9	--	*0.1*
Cargill A13	3.3	0.2	0.2	0 to 0.7	0 to 0.7	--	--
Cargill A15	5.9	0.2	0.1	0 to 0.7	0 to 0.6	--	--
Cargill A16	8.2	0.0	0.0	0.0	0.0	--	--
Cargill A17	8.2	4.6	4.6	4.1 to 5.1	4.1 to 5.1	--	--
Cargill A3E	0.9	0.1	0.1	0 to 0.6	0 to 0.6	*0.1*	*0.1*
Cargill A3W	0.9	0.0	0.0	0.0	0.0	--	--

(A) - Mitigation Components now consist of engineered overflow weir, Alviso levee modifications near County Marina, four (4) engineered gravity drainage outlets for Ponds A5-A8, and exclusion of USFWS Refuge (A6) from flooding by design event.
(B) - Included engineered overflow weir, Alviso levee modifications, six (6) engineered gravity drainage outlets for Ponds A5-A8, and used USFWS Refuge (A6) for flood storage.
(C) - Inundation associated with Guadalupe River, Coyote Creek, and North First Street flood flows.
(D) - Inundation is the greater of Coyote Creek flooding or North First Street overland flood flows.
(E) - If Ponds A9, A10 and A14 are added to UNET they will be subject to several feet of flooding as well.

C:\Projects\50198\Modeling\Unet\Rev6\[Rev6 Results.xls]Tabulated Values


N
A3W
A3E
A4
A5
A6
A7
A8W
A8D
A9
A10
A11
A12
A13
A14
A15
A16
A17
NEW CHICAGO MARSH
RINCON DE LOS ESTEROS
ALVISO
ALVISO SLOUGH
GUADALUPE SLOUGH
COYOTE CREEK
ALAMEDA CO
SANTA CLARA CO
SALT EVAPORATORS
EVAPORATORS
EMBARCADERO DE SANTA CLARA
MOFFETT FIELD
NAVAL AIR STATION

31 May 2001 COPY **A2248/A2248a**

MEMORANDUM FOR RECORD

TO: David Von Rueden, CH2M Hill
Dennis Cheong, SCVWD

CC: Jeff Johnson, NHC

FROM: Loren Murray, P.E. and Robert MacArthur, P.E.

PROJECT: Lower Guadalupe River Flood Protection Project, California.

SUBJECT: Baylands Reconnaissance Study – Provisional Simplified Modeling Results of the Removal of USFWS Refuge (A6) from Interior Flood Storage, nhc 50198.

The following preliminary (provisional) results are based on removing the USFWS Refuge (formerly Pond A6) from potential flood control volume storage between UPRR and the bay.

This initial (interim) analysis includes:

- Modifying the with-LGR Project UNET model by raising the levee between Alviso Slough and Guadalupe Slough that separates the FWS Refuge from potential overflows from Cargill Ponds A5 and A7;
- Modifying the with-LGR Project UNET model by removing the two (2) 8-foot diameter one-way gravity culverts that drain the FWS Refuge;
- Modifying the first six hours of the Lower Guadalupe River LCA (4-day) inflow hydrographs for existing (14k cfs peak) conditions, with-LGR Project and NO stormwater pumping (17k cfs peak), and with-LGR Project including stormwater pumping (20k cfs peak) conditions so that any future modeling conditions will all start with the same initial LGR hydraulic boundary conditions per the 4 May 2001 request by the District.
- All other hydraulic boundary conditions for the Water Pollution Control Treatment Facility, Coyote Creek, San Tomas Creek, Calabazas Creek, Sunnyvale East and Sunnyvale West Drains, and the Dumbarton 10-year tide remain the same as in previous modeling analyses;
- All other baylands mitigation components such as the Alviso-Marina levee, the engineered overflow weir across from Alviso, and the 8-foot diameter one-way gravity drains for Cargill Ponds A5, A7, A8D and A8W remain the same as in previous analyses;
- All other UNET reach-to-storage cell connections, storage-to-storage UNET modeling connections and storage cell-to-reach UNET model connections were not changed for this interim analysis. Work to modify specific model connections is on going. Results from those simulations will be made available in the near future.

The following were not included in this initial (interim) assessment:

- Flooding impacts from N. First St. corridor flooding were computed by hand calculations, and not integrated into the UNET dynamic modeling;
- Conversion of the Rincon De Los Esteros UNET storage cell into a routing reach between N. First Street at Highway 237 and the two storage cells representing Alviso and New Chicago Marsh was not done yet;
- Conversion of the New Chicago Marsh Canal from a UNET model storage cell into a routing reach between New Chicago Marsh and Coyote Creek was not done yet.

The estimated (provisional) inundation depths of the baylands study area with A6 removed for temporary flood storage are shown below along with the change in depth compared to previous analyses with A6 utilized for temporary storage:

Area:	Inundation Depth (ft)	Δ in Inundation Depth (ft)
Alviso	6.5(A)	+0.0
Rincon De Los Esteros	0.3(A)	+0.0
New Chicago Marsh	4.7(A)	+0.0
Cargill A5	6.7	**+0.9**
USFWS Refuge (A6)	0.0	+0.0
Cargill A7	6.8	**+0.9**
Cargill A8W	9.1	**+0.7**
Cargill A8D	6.7	**+0.7**
Cargill A11	0.0	+0.0
Cargill A12	0.1	+0.0
Cargill A13	0.0	+0.0
Cargill A15	0.0	+0.0
Cargill A16	0.0	+0.0
Cargill A17	0.0	+0.0
Cargill A3E	0.1	+0.0
Cargill A3W	0.0	+0.0

Notes:

(A) - Inundation depth is the greater of Coyote Creek flooding or N. First Street overland inundation depths (from hand calculations).

Preliminary results show that removing the Refuge lands from potential flood volume storage increases the inundation depths in nearby storage cells A5, A7, A8W and A8D slightly. These results are provisional and may change once other authorized model modifications have been completed. Long duration drawdown (by gravity outlets) of the floodwaters in the Cargill ponds A5 through A8 will be included in the analysis once all the UNET model modifications have been incorporated.

COPY

24 May 2001 **A2248/A2248a**

MEMORANDUM FOR RECORD

TO: David Von Rueden, CH2M Hill
Dennis Cheong, SCVWD

FROM: Loren Murray, P.E. and Robert MacArthur, P.E.

PROJECT: Lower Guadalupe River Flood Protection Project, California

SUBJECT: Supplemental Baylands Reconnaissance UNET Modeling in Support of Draft EIR and Engineer's Report, nhc 50198.

The purpose of this memorandum is to request District approval for the proposed modifications to be made to assess a new set of physical and hydrologic boundary conditions in the Baylands. Changes to the UNET models are to support the Draft EIR and Engineers Report. The proposed modifications were briefly discussed during the 4 May 2001 Team Meeting. This memorandum describes the modifications in greater detail, and asks the District for approval to implement these modifications and proceed with the additional numerical analyses outlined below. This memorandum also seeks review and guidance on reconnaissance-level hydrology developed for the North First St. corridor. Lastly, this memorandum also reports the results of the site assessment on 22 May 2001 of both the New Chicago Marsh Canal as well as the Rincon De Los Esteros area north of Highway 237.

The following task descriptions summarize **nhc's** understanding of the purposes for each task and briefly outlines proposed methods for accomplishing each task.

Model Modifications for Hydraulic Analysis:

1. Modify USFWS Refuge UNET cell (A6) to reflect most current modifications to levee separating A6 from Cargill Ponds A5 and A7 – The actual levee traversing between the Guadalupe and Alviso Sloughs has recently been raised. The U.S. Fish and Wildlife Service is interested in isolating the refuge from the Cargill salt ponds and re-establishing its connectivity to the bay. The revised District model will simulate the height of the levee between the Refuge (A6) and Cargill Ponds A5 and A7 to a top-of-levee profile established by a straight line from the east levee of Guadalupe Slough to the west levee of Alviso Slough (See Figure A). The two one-directional gravity drains previously installed in A6 as part of the baylands mitigation components will be removed. Each of the Cargill ponds A5, A7, A8D and A8W will continue to have one gravity drain each. The Refuge storage cell in the SCVWD model will not be opened up to the tide (as is being considered by the USFWS). These modifications will essentially remove A6 from the model as a potential flood storage and conveyance area.

2. UNET Model Modifications for New Chicago Marsh Canal – The New Chicago Marsh Canal (NCMC) will be converted from a UNET storage cell to a routing reach. Cross-sections will be developed based on available topographic survey data previously collected by CH2M Hill (2000) and Kier and Wright (1998). The south end of the NCMC will be designated as the upstream end, and the north end at Coyote Creek will be designated as the downstream boundary for the new reach. Overflow weirs will be defined at the boundaries between NCMC and Cargill Ponds A13, A15, A16 and A17 (similar to existing model connections). **Nhc** will continue using the present connection between New Chicago Marsh and NCMC as a low broad-crested weir. **Nhc** will try to simulate the current downstream boundary connection to Coyote Creek as a combination weir and conduit (as presently exists in the field). For these modeling activities, **nhc** will assume that the slide gate on the north end of the conduit is fully open. Channel roughness will be approximated based on photographs and videotape images of the channel reach (taken during the field visit of May 22nd). At present, only three cross-sections have been surveyed for the NCMC. **Nhc** will straight-line the invert elevations between these surveyed sections, and duplicate the known cross-section shapes along this delineated invert profile. **Nhc** will plot up the cross-sections showing the roughness coefficients and fax to the District for review and approval before proceeding with the analysis.

3. UNET Model Modifications for Rincon De Los Esteros (RDLE) – The RDLE will be converted from a UNET storage cell to a routing reach. The upstream end of the reach will be defined at Highway 237, and the downstream reach boundary will be defined as two broad-crested weirs: one spilling overland into Alviso, and the other spilling overland into New Chicago Marsh. A low flow channel (required for UNET to run) will be established between Highway 237 and New Chicago Marsh (mimicking an existing drainage path through RDLE about midway between N. First Street and Zanker Road. New commercial development in the Nortech Parkway vicinity will be included as blocked obstructions in the cross-sections since these facilities completely restrict flow traversing from N. First Street northwest toward Alviso. Once developed, **nhc** will fax cross-sections to the District for review and approval before proceeding with the analysis.

Hydrologic Boundary Conditions:

1. Modifications to initial flow boundary conditions on Guadalupe River in UNET: The initial Guadalupe River flow boundary conditions for both "existing" and "with-project" conditions have been adjusted to use the same flow rates for the first six hours of simulation (see Figure B).

The following presents **nhc's** methodology for completing the preliminary assessment of the hydrology in the City of San Jose, CA, along the North First Street corridor between I-880 and Hwy 237 in the north south direction and Lower Guadalupe River and Coyote Creek in the east-west direction. Key assumptions reflected in this assessment are also noted.

2. A runoff hydrograph from the N. First St. basin was developed and combined with an expected breakout flow hydrograph from the Lower Guadalupe River during a 100 year,

17,000 cfs design flood. Up to 3,000 cfs is expected to breakout upstream of the Highway 237 bridge where the existing capacity of the river is around 14,000 cfs.

Information provided to **nhc** necessary to complete the preliminary hydrology (in order to develop a hydrograph of the interior drainage) along the North First Street corridor was limited. Engineering judgment was used to estimate current land use and existing drainage facilities in the area.

2. In order to generate the hydrograph for the interior drainage area along the N. First Street corridor, **nhc** utilized Section 3 and Section 5 of the District's 1998 Hydrologic Procedures[1] (hereinafter referred to as "Hydrologic Procedures"). The U.S. Army Corps of Engineers' "Flood Hydrograph Package", HEC-1[2] was used following the guidelines of Hydrologic Procedures as the primary tool to generate an estimated hydrograph, but other methods were also used to check that the HEC-1 results were within reasonable limits. The approach is simplified and is intended to provide "ballpark" estimates of possible flow conditions from N. First St. **Nhc** believes these results are acceptable for this reconnaissance-level assessment, but recommends that more detailed analyses of N. First Street. Corridor rainfall runoff and flood routing should be undertaken as part of future feasibility-level studies.

Following are brief descriptions of our approach:

Estimated Basin Area

Area of the basin was delineated by planimeter from 7.5 minute United States Geological Survey Quadrangles. The resulting area was determined to be:

☐ A, area = 5.52 sq.mi.

Estimation of Runoff Volume

Two methods were used to calculate the 4-day, 100-year storm runoff volume for this basin. Both methods required the determination of the precipitation excess, which was then multiplied by the basin area to calculate the runoff volume. The first was the Soil Conservation Service (SCS) method, as outlined in Section 5 of the Hydrologic Procedures. The SCS method requires the determination of a curve number, to describe the level of pervious area in the basin. Without a rigorous study of the soils and current land uses available, it was assumed that the majority of the basin is commercial and business urban districts. This assumption requires the selection of a curve number between 89 and 95 from "Table F.3 Runoff Curve Numbers for Urban Areas" of the Hydrology Procedures. To calculate the precipitation excess, the precipitation for the required storm event must be determined. The precipitation depth for the 4-day, 100-year storm provided in "Exhibit C.2.6 City of San Jose" of the Hydrologic Procedures was compared to the precipitation depth calculated using the Return Period Duration Specific Regional Equation in section 3.4.3 of the Hydrologic Procedures. Both precipitation depth values were within 0.03 inches of each other, so the depth calculated with the regional method was used with the SCS method to calculate the precipitation excess. The second method used HEC-1 to calculate the volume. Methods outlined in the Hydrologic Procedures were applied to the Clark Unit Hydrograph technique to estimate the event runoff. Estimated excess runoff volume totals for the 4-day, 100-year storm are tabulated below:

☐ SCS Method = 1463 acre-ft
☐ HEC-1 = 1659 acre-ft

Determination of Peak Discharge

Three methods were employed to calculate a peak discharge for the basin during a 4-day, 100-year storm event. The first method used the regional equation from "Development of Regional Regression Equations for Solution of Certain Hydrologic Problems and Adjacent to Santa Clara County"[3]. The second method was the Rational Method. This required some assumptions about the land use in the basin and a runoff coefficient (C) of 0.9 was selected. This was based on the likelihood of a majority of the basin being covered in paved impervious surfaces. The rainfall intensity was used directly from "Exhibit C.1.6 City of San Jose" of Hydrologic Procedures. The third method used to calculate a peak discharge was HEC-1. Following the guidelines of the Hydrologic Procedures, a Clark hydrograph method was used to calculate the hydrograph for this basin. Tabulated below are the results from the three methods:

☐ Regional Equation, $Q_{peak} = 1834$ cfs
☐ Rational Method, $Q_{peak} = 2847$ cfs
☐ HEC-1, $Q_{peak} = 2374$ cfs

4. The estimated "existing" conditions N. First Street runoff hydrograph proposed for use in the UNET modeling is shown in Figure C. This figure shows the excess LCA hydrograph discharges discussed in paragraph 2 above, excess N. First St. corridor runoff estimated in paragraph 3 above, and the combined runoff for a 4-day event. The results of the HEC-1 runoff (peaking at ~2,400 cfs) was used to represent the N. First St. runoff based on the results of the three methods shown in paragraph 3 above.

Site Visit Findings:

1. NCMC is bounded to the east and west by non-engineered Cargill levees consisting of bay mud dredged and piled at the salt pond boundaries. The NCMC also contains the UPRR alignment between the Cargill levees creating, in essence, two parallel channels or canals. There are no east-to-west (i.e.- normal to the NCMC alignment) culverts or passages underneath the UPRR alignment between NCMC and Triangle Marsh to the north. The northern boundary of the NCMC is a levee berm connecting the two Cargill north-south aligned salt pond levees. The height of the NCMC west levee, the UPRR railroad grade, and the northern boundary are at the same height (+/- six inches). The height of the NCMC east

levee appears to be approximately two (2) feet higher than the railroad tracks and the NCMC west levee. The canal formed between the railroad grade and the east salt pond levees (A16 and A17) is connected to Triangle Marsh by a 36-42" CMP culvert with a slide gate on the north end. Coyote Creek flood flows must pass through this culvert (or over the berm constructed above the culvert) and flow southward into New Chicago Marsh. Likewise, given sufficient flooding in New Chicago Marsh, floodwaters can potentially traverse northward through this eastern canal, and through the culvert into Triangle Marsh. The canal formed between the west levee and the railroad tracks does not have any conduit or below-levee-crown connection with Triangle marsh to the north. The only way for floodwaters from Coyote Creek to enter this western canal is to overtop the northern boundary, overtop the A15 and/or A13 pond levee, overtopping from the railroad grade, or from New Chicago Marsh to the south. Nhc proposes treating this western canal as ineffective conveyance area since it presently has not flow-through capability (dead-end storage only). ***Nhc requests approval from the District to model this western canal as ineffective flow between New Chicago Marsh and Triangle Marsh (passive flow through capability does not exist).***

2. Significant development has occurred in the historical floodplain corridor through RDLE. Much of the development upstream or south of Alviso is commercial development consisting predominantly as high-technology businesses. Other present-day physical features affecting the path of overland flow from N. first Street include the landfill east of Alviso, the water pollution control treatment facilities also east of Alviso, Zanker Road offramp from Highway 237-East, and the onramp and offramp fills for the N. First St. cross-over of Highway 237. The flood path west of N. First St. is entirely obstructed along the south side of Highway 237 by a 15-foot tall, continuous concrete block soundwall from N. First St. to the east Lower Guadalupe River levee. Figure D depicts flow restrictions along the N. First St. corridor identified during the May 22nd site visit. Unless specified otherwise by the District, all of the commercial building facilities in the floodway will be delineated in the UNET modeling as blocked obstructions. ***Nhc requests approval from the District to model these existing buildings and/or infrastructure as blocked obstructions.***

Schedule:

The following table is an estimated schedule of completing the necessary tasks to complete these assignments in support of the Draft EIR and Engineer's Report:

Activity(ies)	Approx Date
Start writing up definition of hydrologic boundary condition for N. First St. (~Fri - Mon)	18-21 May
Start writing up definition of the hydraulics analysis model modifications (~Mon - Wed)	21-23 May
Site visit to RDLE and NCMC early next week (~Tue)	22 May
Submit hydrologic boundary condition definition to District for approval (~Thur)	24 May
Submit hydraulics analysis modification procedures to District for approval (~Thur)	24 May
Hydrologic B/C: If approved by Fri, generate model boundary conditions (~2nd Tue)	29 May
Hydraulics mods: If approved by Fri, start collecting data and develop model code (~ 2nd Tue – 2nd Fri) (Mon is a holiday; Includes: RDLE Δ, NCMC Δ, A6 Levee Δ)	29May-1Jun
Insert B/C mods and routing reach mods into model and debug (~3rd Mon - 3rd Wed)	4-6 Jun
Make production runs and interrogate results; tune model (~3rd Thur - 3rd Fri)	7-8 Jun
Raw data results available to District, JSA & HTH	11 Jun
Tech Memo write-up and submittal to District for Review	12-14 Jun
Meet with District to discuss results	15 Jun
Finalize Memo to District	18-20 Jun

Nhc requests timely review of these proposed procedures, followed by telephone conferencing to discuss any District refinements or adjustments (if any). A simple emailed or faxed approval directive to proceed with analyses will be sufficient for **nhc** to continue these expedited assignments.

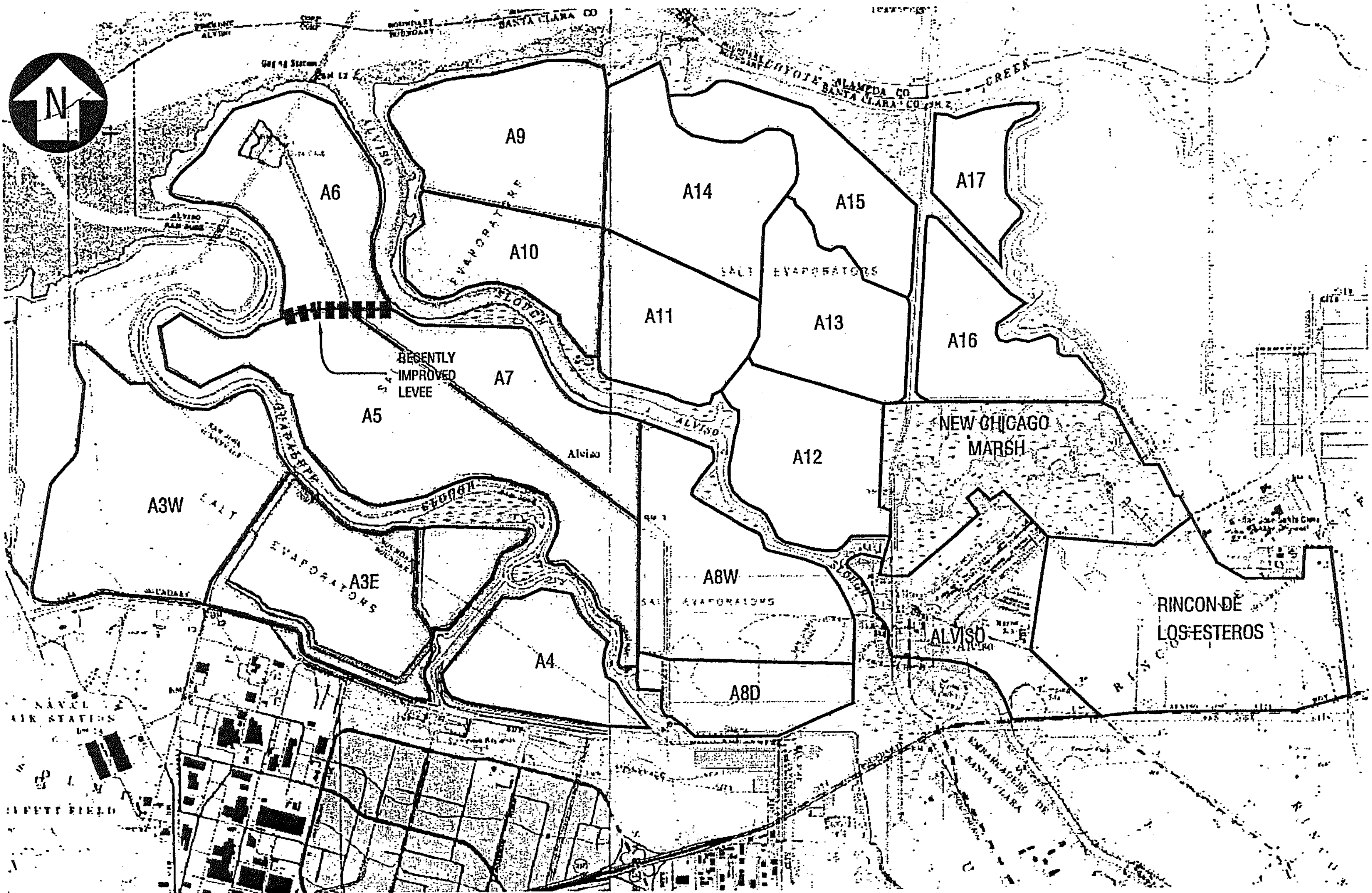
ENCL (4 Figures)

References

1. Wang, J., Chang, W., Marks, T., Tabios III, G.C., "Hydrologic Procedures", Santa Clara Valley Water District, Water Resource Management Group Hydrology and Geology Unit, December 1998.

2. U.S. Army Corps of Engineers, Hydrologic Engineering Center, Davis, CA, "HEC-1 Flood Routing Package", September 1990.

3. Saah, A.D., Talley, R., Sanchez, Jr., W.J., "Development of Regional Regression Equations for Solution of Certain Hydrologic Problems in and Adjacent to Santa Clara County-DRAFT", Santa Clara County Water District, November 1976.



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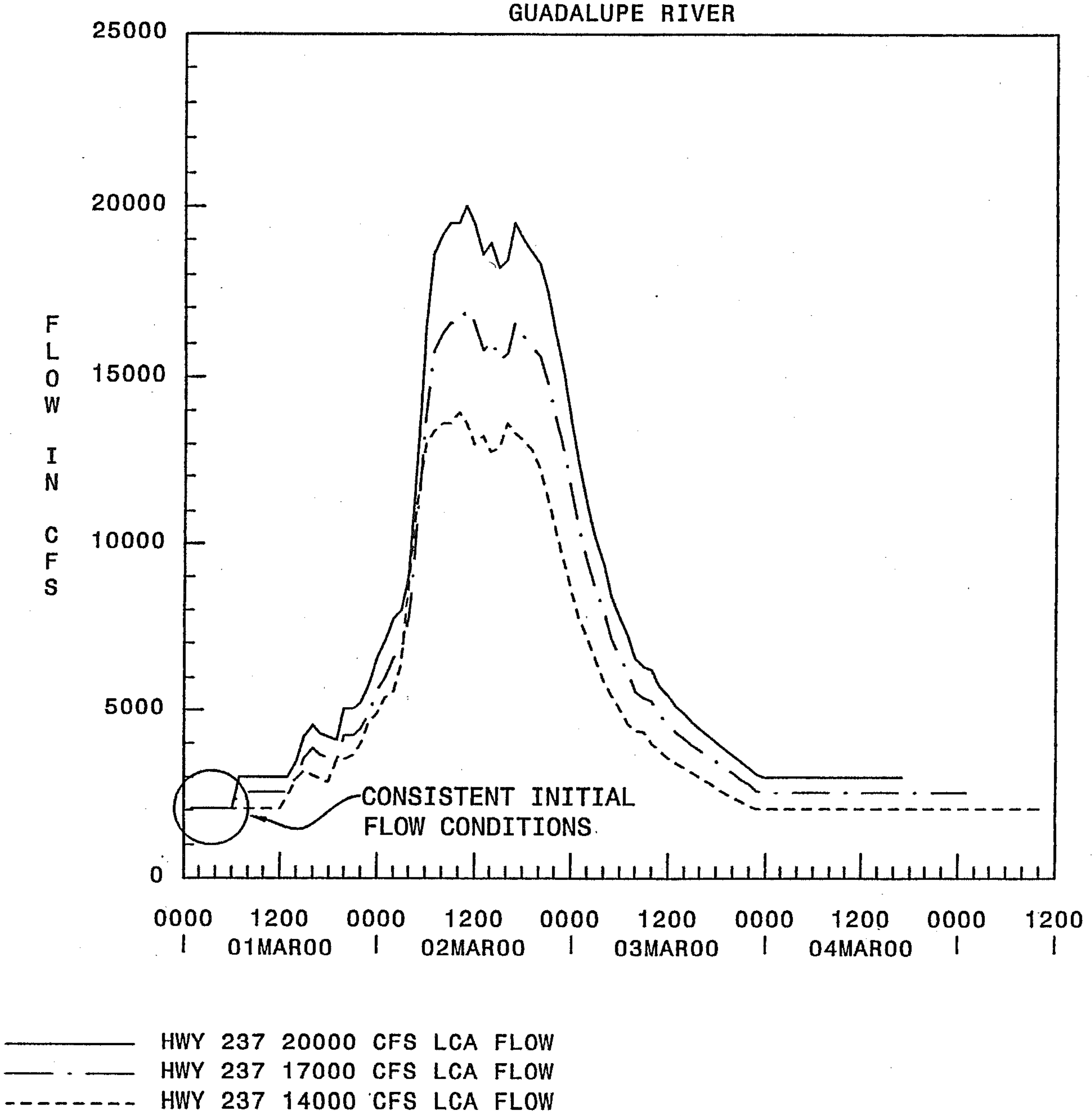
(916) 371-7400

HISTORICAL GUADALUPE RIVER CHANNEL ALIGNMENT
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE A
May 2001



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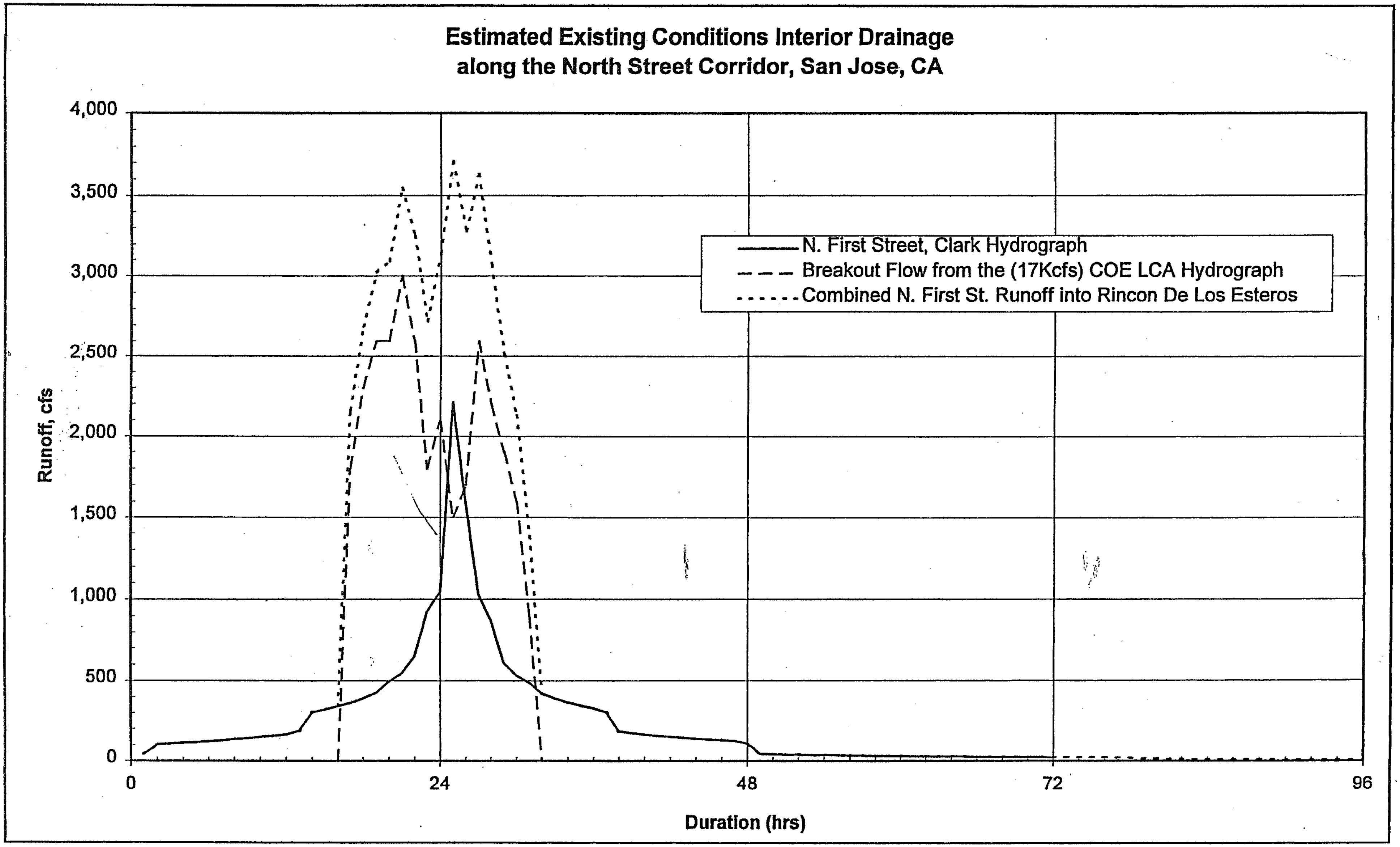
CONSISTENT INITIAL GUADALUPE RIVER FLOW CONDITIONS
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE B
May 2001



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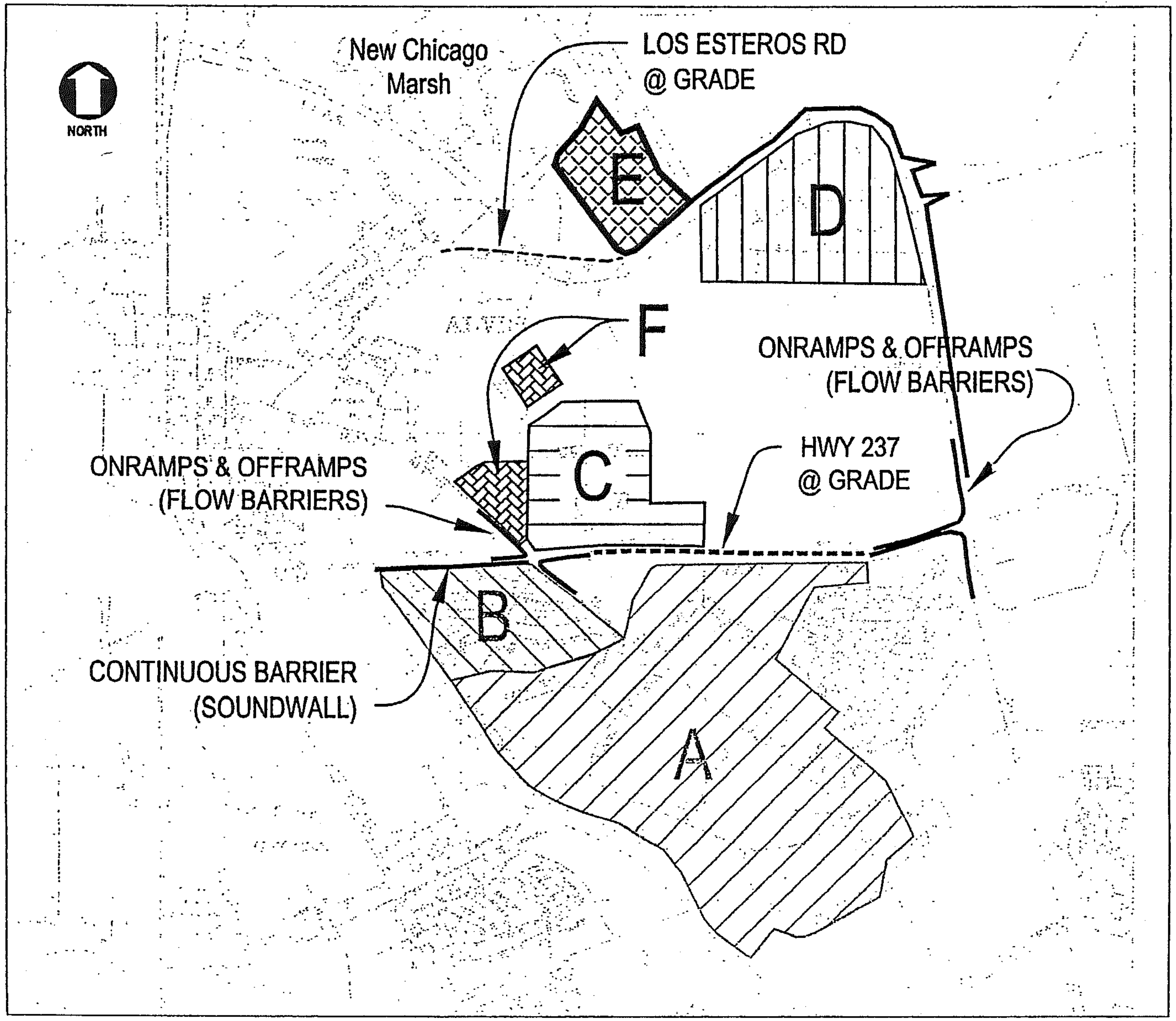
ESTIMATED EXISTING CONDITIONS NORTH FIRST STREET RUNOFF
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY – UPRR TO THE BAY

FIGURE C
May 2001

NFIRSTLAND-USE.DWG


NORTH
New Chicago Marsh
LOS ESTEROS RD @ GRADE
E
D
F
ONRAMPS & OFFRAMPS (FLOW BARRIERS)
C
HWY 237 @ GRADE
ONRAMPS & OFFRAMPS (FLOW BARRIERS)
B
CONTINUOUS BARRIER (SOUNDWALL)
A

LEGEND:

- **A** Commercial buildings with first floor at existing grade.
- **B** Single-family residential (mobile homes) between 0–2' above existing grade.
- **C** Commercial/Industrial facilities approx. 4–5' above existing grade.
- **D** Water pollution control facility is approx. 3' above existing grade.
- **E** Active Landfill creates 20–30' barrier above the existing floodplain.
- **F** Newly constructed or under construction commercial facilities approx. 8–9' above existing grade.

nhc

northwest hydraulic consultants, inc.
3950 industrial boulevard, suite 100c
west sacramento, california 95691
(916) 371-7400

LAND USE IMPEDIMENTS TO OVERLAND FLOW
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE D
May 2001

COPY

8 May 2001 A2248/A2248a

MEMORANDUM FOR RECORD

TO: David Von Rueden, CH2M Hill

Cc: Jeff Johnson, NHC
Steve Centerwall, J&S

FROM: Loren Murray and Robert MacArthur, NHC

SUBJECT: Lower Guadalupe River Flood Protection Project (LGRFPP) - Supplemental Hydraulic Analysis of the Baylands , nhc 50198.

1. The need for further UNET model refinements and additional modeling tasks were discussed during the team meeting held in San Jose on 4 May 2001. Concurrence regarding the new tasks, methods for refining previous boundary conditions and assumptions, and proposed modeling approach is needed from the District prior to initiating the new assignments. New modeling assignments for the Task 10 – Reconnaissance Studies are summarized in paragraphs 2-6 below.

2. Rincon De Los Esteros – This area is currently modeled as a storage cell in the UNET model. This specific cell will be converted to a broad, very simplified overland channel reach starting from Highway 237 (HWY237), continuing downstream to Alviso and New Chicago Marsh (NCM). The upstream boundary will receive a flow hydrograph as input. The distribution of the hydrograph along the HWY237 boundary has not yet been determined. The downstream boundary will be defined as two broad-crested weirs defined by the geometry that bounds Rincon De Los Esteros (RDLE) and Alviso, and between RDLE and NCM. Unless the District can provide some topography for this region (bounded by: HWY237, Coyote Creek, County Treatment Plant, New Chicago Marsh, Alviso, LGR east levee to HWY 237), **nhc** will use U.S.G.S. quadrangle maps for the area and estimate the topography to be used for the cross-sections for the routing reaches. Any new topographic data will be provided to CH2M Hill and **nhc** by 15 May 2001. The District will specify the appropriate RDLE channel roughness coefficients to be used for overbank and main channel portions of the cross-sections. (Note: **nhc** is unaware of ultimate, future build-out conditions planned for RDLE and is not planning an evaluation of these conditions. Results for future conditions are likely to change flow routing through RDLE.)

3. N. First Street Hydrographs – Flow from the N. First St. corridor needs to be specified at the upstream boundary of the RDLE reach. For this upstream boundary, flow hydrographs for both "existing" as well as "with-LGR Project" conditions will be developed. **Nhc** will generate the N. First St. hydrographs and submit them to the District for approval. The basis for these hydrographs are described as follows:

a. Existing Conditions: This hydrograph consists of two components: the excess LGR (river capacity of 14,000 cfs) overtopping flows estimated to peak at 3,000 cfs, commingled with estimated local storm drainage runoff between I-880 and HWY237. The detailed description of the generation of these data will be provided as part of the submittal for District approval.

b. With-Project Conditions: This hydrograph consists of the estimated local storm drainage runoff between I-880 and HWY237 estimated to peak at around 3,000 cfs. The detailed description of the generation of this N. First St. flow boundary condition will also be provided as part of the submittal for District approval.

4. USFWS Refuge (A6) – This component of the UNET model is presently a storage cell. This cell is isolated from Cargill ponds A5 and A7 by a levee with an elevation determined from old Cargill pond mapping. (CH2M Hill became aware that the USFWS recently raised the levee so as to further isolate the refuge from Ponds A5 and A7.) Under new, refined "existing" conditions simulations, this cell will be further isolated within the model by raising the levee to the height of the adjoining Alviso and Guadalupe Slough levees. Under "with-project" conditions simulations, this cell will also be isolated from the model, and its two uni-directional gravity drains will also be removed. These two drains will not be relocated to other locations to help drain A5 and A7. The model will not simulate A6 being opened up to the South Bay tides.

5. Same Initial Conditions – The "with-project" Guadalupe River hydrograph will be modified for the first three hours to coincide with the runoff values occurring during the first three hours of flow routing for the "existing" conditions hydrograph so the two initial conditions match. No changes are necessary for any of the other hydraulic boundary conditions.

6. New Chicago Marsh Canal – The NCM Canal is depicted in the UNET model as a storage cell. **Nhc** will change this cell to a "routing reach" and reconnect all appropriate cells and boundary conditions. **Nhc** assumes that the presently available geometry for the NCM Canal is sufficiently accurate for this evaluation. The District will specify what roughness coefficients to use for the overbank and main channel portions of the cross-sections along the revised NCM Canal routing reach.

7. Duration Analysis – Once the new flow boundary conditions, pond and channel configurations are reviewed and accepted by the District, **nhc** will re-run the "existing" and "with-LGR Project" conditions. Nhc will also re-evaluate the time necessary to drain Ponds A5, A7, A8W and A8D for the two conditions and prepare a revised summary of the results, including a table and map showing ponds affected by the flooding for the two conditions.

8. Unknown Impacts – Part of the mitigation plan for the LGRFPP in the baylands region is to improve the Alviso Slough levee in the vicinity of the Marina. To protect against potential Alviso, RDLE and NCM flooding as a result of a failure of the east Alviso Slough levee *(refer to the 27 February 2001 Memorandum, "Supplemental Baylands Incremental Analysis Results")* downstream of the Marina, some form of levee or floodwall configuration has been

recommended by the Team. The location, extent, dimension or alignment of this feature is yet to be determined. It may wrap around the Marina and continue along the east levee of Alviso Slough. It may extend from the Marina northward paralleling the UPRR alignment, or it may wrap eastward between the Town of Alviso and NCM, possibly all the way to the County treatment plant. This alignment may impose design-related impacts which are unknown and un-quantified at this time. In addition, with the routing of N. First St. flood flows into this area, an interior flooding condition may be created if these routed flows are prohibited from getting to the bay as a result of this new mitigation component. This feature, its impacts on the hydraulic regime in the Alviso- RDLE-NCM vicinity, and any possible design or environmental impacts have yet to be evaluated or qualified and are not part of this new work assignment.

COPY

30 April 2001 **A2248/A2248a**

MEMORANDUM FOR RECORD

TO: Dennis Cheong, SCVWD
David Von Rueden, CH2M Hill

Cc: Jeff Johnson, NHC

LAM RCM

FROM: Loren Murray, P.E. and Robert MacArthur, P.E.

SUBJECT: Lower Guadalupe River Flood Protection Project - Supplemental Hydraulic Analyses for the Baylands Study Area, nhc 50198, Task 09.01.00.

---

1. Dr. Wang requested a copy of the baseline UNET model for the baylands during the 29 March 2001 meeting in San Jose. NHC transmitted the baseline model to CH2M Hill on16 April via email. NHC developed the baseline model during the spring of 2000. It is documented in the Draft Baylands Reconnaissance Report (NHC, 2000). The baseline model is *the basis for the evolution* of all subsequent versions of the UNET model and the subsequent unsteady flow sensitivity, incremental analyses and scenario evaluation modeling that has been done in the baylands since then. This model and all subsequent versions of the UNET model, including all subsequent sensitivity runs and scenario simulations, were executed using UNET Version 3.2.0, dated August 1997.

2. Several refinements have been made to the original baseline UNET model since early 2000 in order to: a) include new information and hydraulic boundary conditions as they became available, b) to describe refined "Existing Conditions" in the baylands as those conditions became more clearly defined by the District, c) to describe "With-project Conditions," e.g., with conceptual baylands mitigation components, d) to evaluate incremental differences in flood depths for various flood and project scenarios, and most recently to e) estimate the time necessary to drain ponds A5 through A8 via gravity drains following a design event, given certain key assumptions.

3. Enclosed with this memorandum are the most recent UNET models for a) *Existing Conditions* (April 2001), and b) *With-Project Conditions* (April 2001). The following criteria and boundary conditions distinguish each of the two models:

    a. Existing Conditions, as of April 2001:

        i. Four-day, 14,000 cfs peak flow hydrograph on Lower Guadalupe River reaching Highway 237; hydrograph volume needs to be verified; UNET modeling reach is from Hwy 237 to the Bay;

        ii. Assumes no LGR project components have been constructed;

        iii. One-percent storm events occur on all other tributaries;

        iv. Coyote Creek hydrograph lagged per SCVWD recommendation;

v. 10-Yr tide at Dumbarton Bridge;

vi. No N. First St. interior flood routing included in UNET model;

vii. N. First St. flooding into baylands estimated by hand calculations previously approved by District (J. Wang) in September 2000;

viii. No improved flood protection to Alviso from either Coyote Creek or Alviso Slough, e.g., " depicting existing conditions" as best we know them from available information as of April 2001;

ix. No baylands improvements to Alviso Slough overtopping locations;

x. No baylands improvements to fill or drain ponds;

xi. Uses available bathymetry for South Bay, Coyote Creek and Guadalupe Slough; aware of areas where levee geometry and channel bathymetry needs to be verified.

b. With-Project Conditions, April 2001:

i. Four-day, 17,000 cfs peak flow hydrograph on Lower Guadalupe River reaching Highway 237; UNET modeling reach is from Hwy 237 to the Bay;

ii. Both the LGR and Downtown Projects have been constructed, with all improvements stopping at UPRR; no dredging is included;

iii. No stormwater pumping during four-day, 17,00 cfs event; design hydrograph volume needs to be verified;

iv. One-percent storm events on all other tributaries;

v. Coyote Creek hydrograph is lagged per SCVWD recommendation;

vi. 10-Yr Tide at Dumbarton Bridge;

vii. No N. First St. interior flood routing included in UNET model;

viii. N. First St. flooding estimated by hand calculations previously approved by District (J. Wang) in September 2000;

ix. Town of Alviso protected from Guadalupe River overtopping along Alviso Slough (east levee) and the County Marina area;

x. No improved flood protection to Alviso from Coyote Creek or N. First Street, e.g., "depicting existing conditions for these sources of flood waters" as best we know them from available information as of April 2001;

xi. An improved weir is in place on the west bank of Alviso Slough at approximately river mile 4.21 to allow excess LGR-Alviso Slough floodwaters to spill into Cargill and USFWS ponds; low invert of weir crest set to same elevation of earthen weir crest there today;

xii. Cargill Ponds A5, A7, A8D, A8W each have only one, uni-directional (outflow only), 8-ft. diameter gravity drainage conduit to drain each of them; the USFWS Refuge (A6) has two (2), uni-directional, 8-ft. diameter gravity drainage conduits to drain it.

xiii. Uses available bathymetry for South Bay, Coyote Creek and Guadalupe Slough; aware of areas where levee geometry and channel bathymetry needs to be verified.

4. Hand calculations and FEMA FIS mapping information were used to estimate contributions to flooding in the areas north of Highway 237 from the North First Street Corridor for two conditions: a) estimated 6,000 cfs entering the N. First St. corridor from the LGR and local interior runoff along N. First St. [e.g., Existing, No-LGR Project Conditions assumptions], and b) estimated 3,000 cfs entering the N. First St. corridor [e.g., With LGR and DT projects and no interior pumping into LGR assumptions]. Below is a summary of how calculations were performed for both conditions:

    a. Existing (No LGR Project) Conditions:

        i. Inflow from the Guadalupe River watershed for the design event is the four-day, 17,000 cfs peak discharge (LCA) hydrograph;

        ii. Existing local maximum capacity of the LGR project is assumed to be 14,000 cfs, and thus all discharges above 14,000 cfs (up to 3,000 cfs) on the LCA hydrograph spill out into the N. First St. corridor just upstream of Hwy 237;

        iii. The duration of the 3,000 cfs excess spillage is approximately 20 hours (based on the LCA hydrograph shape;

        iv. Local inflows for interior runoff in and around N. First Street are up to 3,000 cfs, for a similar duration of 20 hours;

        v. Assumptions (iii) and (iv) result in a total aggregate interior flood of approximately 6,000 cfs lasting up to 20 hours; it is assumed that 1/3rd of the volume from this interior flooding is stored in local depression storage, thus allowing 4,000 cfs for 20 hours to pass Highway 237 northward down the N. 1st Street corridor.

        vi. The volume for the remaining 2/3rds of the runoff is computed by hand resulting in estimated ponding depths in the three dominant ponding areas (Rincon De Los Esteros, Alviso, and New Chicago Marsh);

        vii. The estimated depths of flooding from N. First St. corridor flows are listed below:

Alviso:	8.8 ft.	*(N. First St)*
Rincon De Los Esteros:	2.8 ft.	*(N. First St)*
New Chicago Marsh:	5.3 ft.	*(N. First St)*

viii. The results of the UNET modeling indicated flood depths (from riverine and tidal conditions primarily from Coyote Cr.) to these same areas equal to:

• Alviso:	4.8 ft.	*(from UNET)*
• Rincon De Los Esteros:	0.0 ft.	*(from UNET)*
• New Chicago Marsh:	4.8 ft.	*(from UNET)*

ix. NHC estimated depths of flooding in Alviso, Rincon De Los Esteros, and New Chicago Marsh from riverine and tidal sources separate from the N. First St. overland flood threat. UNET was used to compute potential river and tidal flooding and independent hand calculations were used to estimate flood depths from the N. First St. corridor. NHC assumed that flood depths would be the greater of the two sources and did not attempt to route or combine these two effects. The greater inundation depth of paragraphs "4.a.vii" and "4.a.viii" above are presented in Table 1.

b. With-LGR Project Conditions:

i. Inflow from the Guadalupe River watershed for the design event is the four-day, 17,000 cfs peak discharge (LCA) hydrograph; no pumping into LGR; hydrograph volume needs to be validated;

ii. Local inflows for interior runoff in and around N. First St. are up to 3,000 cfs, for a similar duration of 20 hours during the design event; interior drainage volumes need validation;

iii. Assumptions (i) and (ii) result in a total aggregate interior flood of approximately 3,000 cfs lasting up to 20 hours; it is assumed that 1/3rd of the volume is stored in local depression storage, thus allowing 2,000 cfs for 20 hours to pass Highway 237 northward down the N. 1st Street corridor;

iv. The volume for the remaining 2/3rds of the runoff is computed by hand resulting in estimated ponding depths in the three dominant ponding areas (Rincon De Los Esteros, Alviso, and New Chicago Marsh);

v. The estimated flooding depths from the N. First St. corridor flows are listed below:

• Alviso:	6.5 ft.	*(N. First St)*
• Rincon De Los Esteros:	0.3 ft.	*(N. First St)*
• New Chicago Marsh:	2.8 ft.	*(N. First St)*

vi. The results of the UNET modeling indicated flood depths (from riverine and tidal conditions primarily from Coyote Cr.) to these same areas equal to:

• Alviso:	4.7 ft.	*(from UNET)*
• Rincon De Los Esteros:	0.0 ft.	*(from UNET)*
• New Chicago Marsh:	4.7 ft.	*(from UNET)*

vii. As stated in paragraph"4.a.ix" above,NHC assumed that flood depths would be the greater of the two sources and did not attempt to route or combine these two effects. The greater inundation depth of subsections "4.b.v" and "4.b.vi" are presented in Table 1.

IMPORTANT NOTE: The runoff volume assumed for local interior drainage described in this section may be underestimated and needs verification because our understanding of the local storm drainage infrastructure producing the 3,000 cfs is that it is presently design for a 10-year event over the watershed. The design event being assessed in the Reconnaissance Study is significantly larger in magnitude, and is could produce more runoff within the LGR Project reach than is presently estimated. This assumption along with the verification of an appropriate volume of runoff for the design hydrograph are key issues that merit further analyses prior to finalization of project design and final environmental documentation. Future "Feasibility" analyses of the baylands area will require that these assumptions be addressed.

5. Mr. R. Talley, (April, 2001) requested further detailed documentation and analyses regarding (a) baylands tidal conditions, and (b) the long-term "with-project" conditions evaluation of the time necessary to drain Ponds A5-A8 by uni-directional gravity drains only. **A-** NHC provided CH2Mhill with a MEMO (4-11-01) that summarized the baylands tidal conditions and provided cross references between three different vertical datum's that are typically used in the Bay. **B-** NHC explained how they had initially estimated the time to drain ponds A5-A8 in an email sent to Dave Von Rueden on 4-18-01. NHC explained that the "with-project" estimates represented an over-simplified drainage scenario that assumed gravity drainage for 16 days and evaporation loss for the remaining time and agreed to perform a more detailed UNET simulation to estimate how long gravity drains would take to return flooded ponds back to their pre-flood elevations. Results from that assessment follow. The attached Table 1 (initially presented in 27 February 2001; updated 30 April 2001) has been revised to compare existing conditions versus with-project conditions flooding and times to drain the ponds in the baylands study area. The following assumptions were made in estimating the long-duration drawdown analysis for ponds A5 – A8:

   a. Assumed the design storm for the study area starts on 1 March, and is the 4-day, LCA storm hydrograph provided by the District (Feb 2000);

   b. Following passage of the 4-day event, subsequent flows in all the tributaries return to a minimum base flow of 50 cfs within 2-3 weeks following the 4-day storm event;

c. No antecedent or post-event storms occur, e.g., we assume no storm nesting (historical events typify storm nesting) in this analysis; only a single storm event scenario (item b, above) was evaluated. The implication is that, preceding storm events (similar to historical records) could conceivably spill floodwaters into the storage cells thus reducing their initial storage capacity for the subsequent design storm event, or storm events may occur after the design event which could add more volume into the ponds following the event. Thus, these results are based on a very unique set of event volume, event duration and event sequencing assumptions. Design of baylands features will require evaluation of additional event sequencing scenarios.

d. The March tide is a modification of the March 95 tide for Dumbarton Bridge whereby the entire tide cycle for the 4-day storm was amplified (highs and lows) in order to produce a peak tide stage equivalent to the 10-year tide stage for Dumbarton Bridge for the duration of the storm event;

e. Following the passage of the design event, the remainder of the tide for the month of March simulation period is based on the March 1995 tide data at Dumbarton Bridge (NOAA Tides and Currents);

f. The tide for the month of April is based on the NOAA April 1995 tide for Dumbarton Bridge;

g. The drawdown of the flood stages in Cargill Ponds A5, A7, A8D, A8W and the USFWS Knapp Refuge (formerly pond A6) were simulated for two months with the mitigation components in-place; the amount of pond drawdown in each pond was noted at the end of the UNET simulation period;

h. After the two month simulation period the slope of the last 10-days of the computed drawdown curve was used to estimate the remaining rate of drainage occurring in specific ponds. That additional time to drain each pond was then added to the two-month estimate of drainage time computed by UNET to develop an estimated "long-term drainage time associated with gravity drains only;"

i. This long-duration assessment assumes that all non-engineered private levees and/or berms remain intact for the entire duration of flooding and subsequent drawdown and that no other significant rainfall or runoff events affect ponded volumes. Effects of wind set up or other tidal influences are not accounted for.

j. Estimated drawdown duration from gravity drains only to return Cargill Ponds A5-A8 and USFWS Knapp Refuge back to pre-flood elevations are summarized in Table 2, below. Durations vary from 2.3 months in pond A6 to 9.2 months in pond A8W.

k. From a flood control perspective, it is not prudent to assume that these rates of drainage are adequate for dependable project performance. Further project drainage refinements and analyses are suggested.

Table 1
Baylands Inundation for Existing Conditions vs. With LGR+Dntn Projects

Baylands Conditions	Existing Conditions	Project* Conditions
HYDRAULIC INFORMATION:		
Guadalupe River Maximum Flows (in cfs)	14,000	17,000
" " " " (in cms)	396	481
North First Street (from LGR) Flows (in cfs)	6,000	3,000
" " " " " (in cms)	170	85
FLOOD IMPACTS INFORMATION:		
Flooding by Location	**Depths(A) in feet; Δ=±.5'**	
Alviso, California	8.8(B)	6.5(C)
Rincon De Los Esteros	2.8(B)	0.3(C)
New Chicago Marsh	5.3(B)	4.7(C)
Cargill Pond A5	4.5	5.8
FWS Refuge (A6)	-	5.4
Cargill Pond A7	4.6	5.9
Cargill Pond A8W	6.9	8.4
Cargill Pond A8D	4.5	6.0
Cargill Pond A11	-	-
Cargill Pond A12	-	0.1
Cargill Pond A13	-	-
Cargill Pond A15	-	-
Cargill Pond A16	-	-
Cargill Pond A17	-	-
Cargill Pond A3-East	0.1	0.1
Cargill Pond A3-West	-	-
Flooding Durations (days; months; or years)		
Cargill Ponds A5-A8 + USFWS Refuge (w/o Pumping)	2± Years	(See Table 2)
Alviso and Rincon De Los Esteros (w/o Pumping)	???	???
Ponds A5, A7, A8D + USFWS Refuge (w/ 25-cfs Pumps)	42± Days	36± Days
Pond A8W (w/ 25-cfs Pump)	95± Days	88± Days
Ponds A5, A7, A8D + USFWS Refuge (w/ 100-cfs Pumps)	21± Days	18± Days
Pond A8W (w/ 100-cfs Pump)	33± Days	31± Days
*(*** 5 Pumps; Pumps are needed to drain A5-A8)*		
Flood Volumes(D) (Acre-Feet)		
Alviso, California	2,455	1,814
Rincon De Los Esteros	3,238	183
New Chicago Marsh	1,280	2,148
Cargill Pond A5	2,980	3,605
FWS (A6) Refuge	-	2,950
Cargill Pond A7	1,235	1,515
Cargill Pond A8D	860	1,070
Cargill Pond A8W	3,175	3,445
Cargill Pond A12	-	31
Cargill Pond A3-East	54	54
Subtotals:	15,277	16,814

NOTES:

- Project definition has been refined slightly since previous discussions in February 2001 to include six outlets in into Alviso and Guadalupe Sloughs versus five outlets analyzed in previous definitions.

(A) - "With-Project" includes baylands mitigation components including: engineered overflow weir, Alviso levee modifications, engineered gravity-drainage outlets for Ponds A5-A8, authorization to discharge Guadalupe River flood flows into ponds A5-A8.

(B) - Inundation associated with Guadalupe River, Coyote Creek, and North First Street flood flows.

(C) - Inundation is the greater of Coyote Creek flooding or North First Street overland flood flows.

(D) - Volumes include mean monthly precipitation during period of extended flooding.

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Table 2
Pond A5-A8 Drawdown Duration By Gravity Drainage

Storage Cell:	Drawdown Duration[A] *(months)*
Cargill Pond A5	~3.5
Cargill Pond A7	~3.2
Cargill Pond A8W	~9.2
Cargill Pond A8D	~2.6
FWS Refuge (A6)[B]	~2.3

(A) This is the duration starting from the peak of inundation for each cell. Figures of the Drawdown for each pond are provided by facsimile (dated 30 April 01).

(B) This storage cell utilizes two (2) gravity drain conduits whereas the other four ponds only utilize a single barrel per storage cell.

Attachments:

- ☐ Existing Conditions (April 2001) UNET model (electronic cy)
- ☐ With-Project Conditions (April 2001) UNET model (electronic cy)
- ☐ Table 1, "Baylands Inundation" tabulation (FAX only)
- ☐ Figures A-E dated 30 April 2001 (FAX only)

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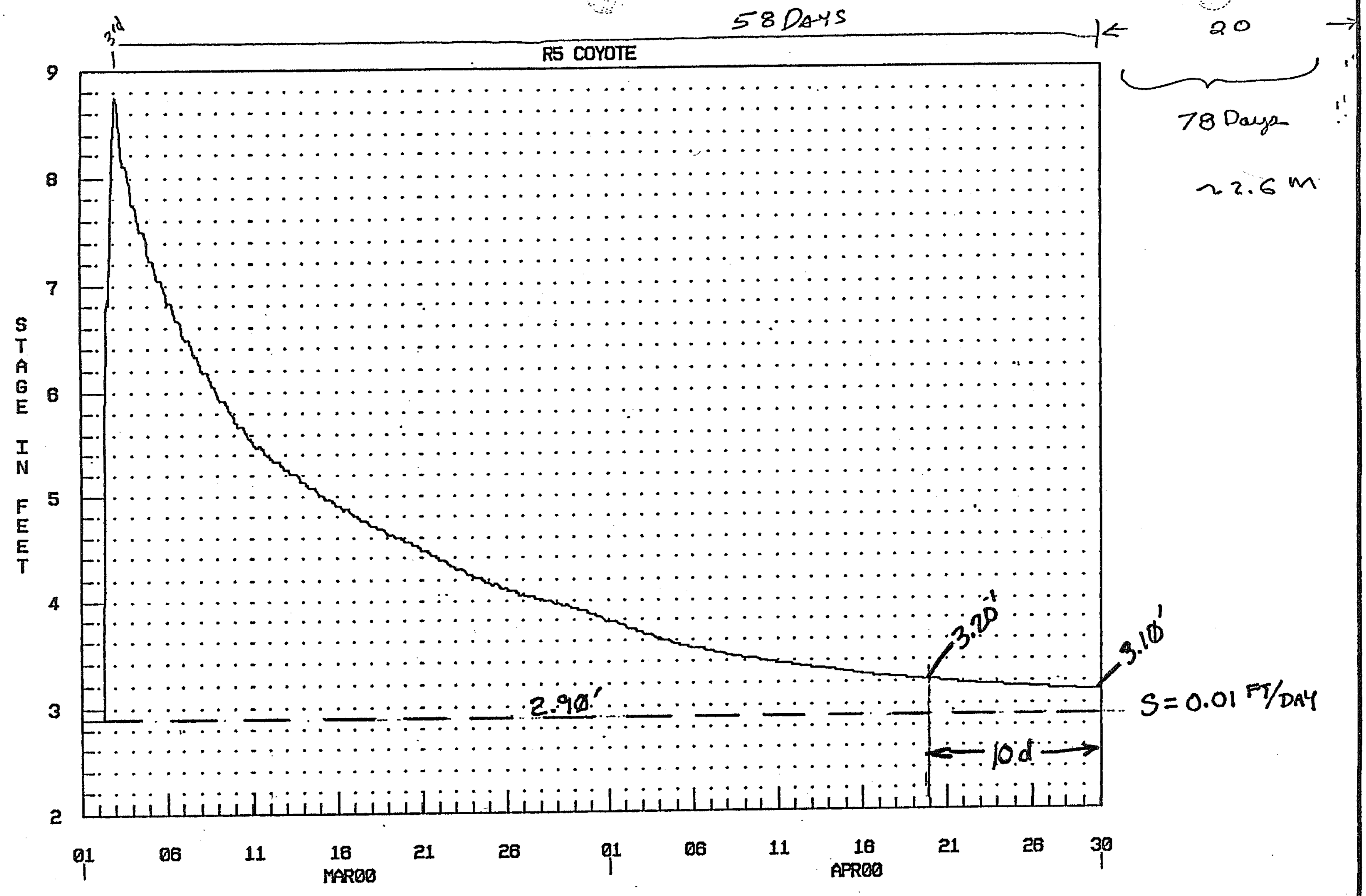
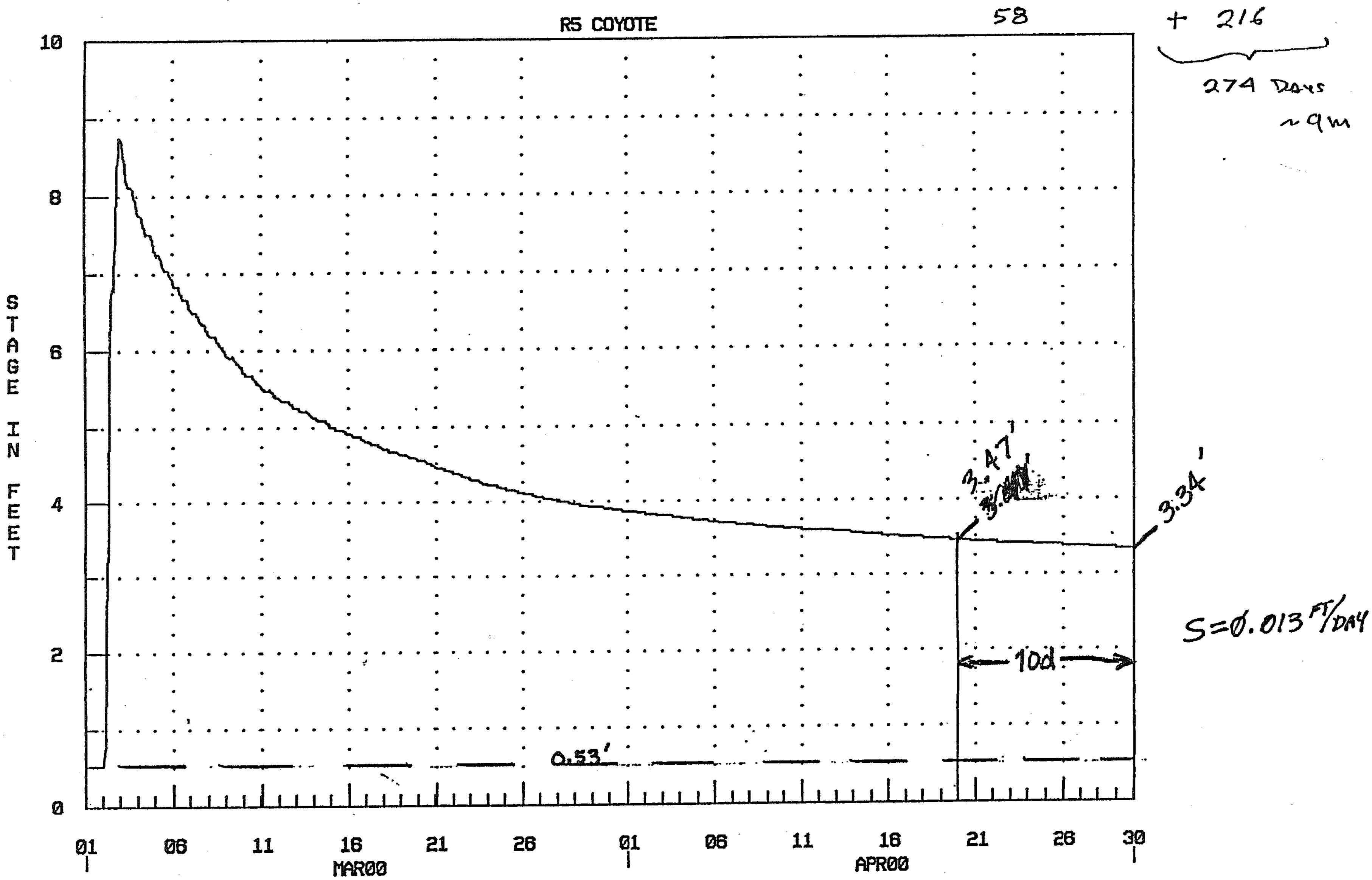


CARGILL A8D WITH LGR STAGE

$$\therefore \text{DAYS TO DRAIN (BEYOND APRIL)} = \frac{(3.10 - 2.90 \text{ FT})}{0.01 \text{ FT/DAY}} \cong 20 \text{ DAYS (PAST 30 APR)}$$

30 APRIL 2001

FIGURE Ⓐ

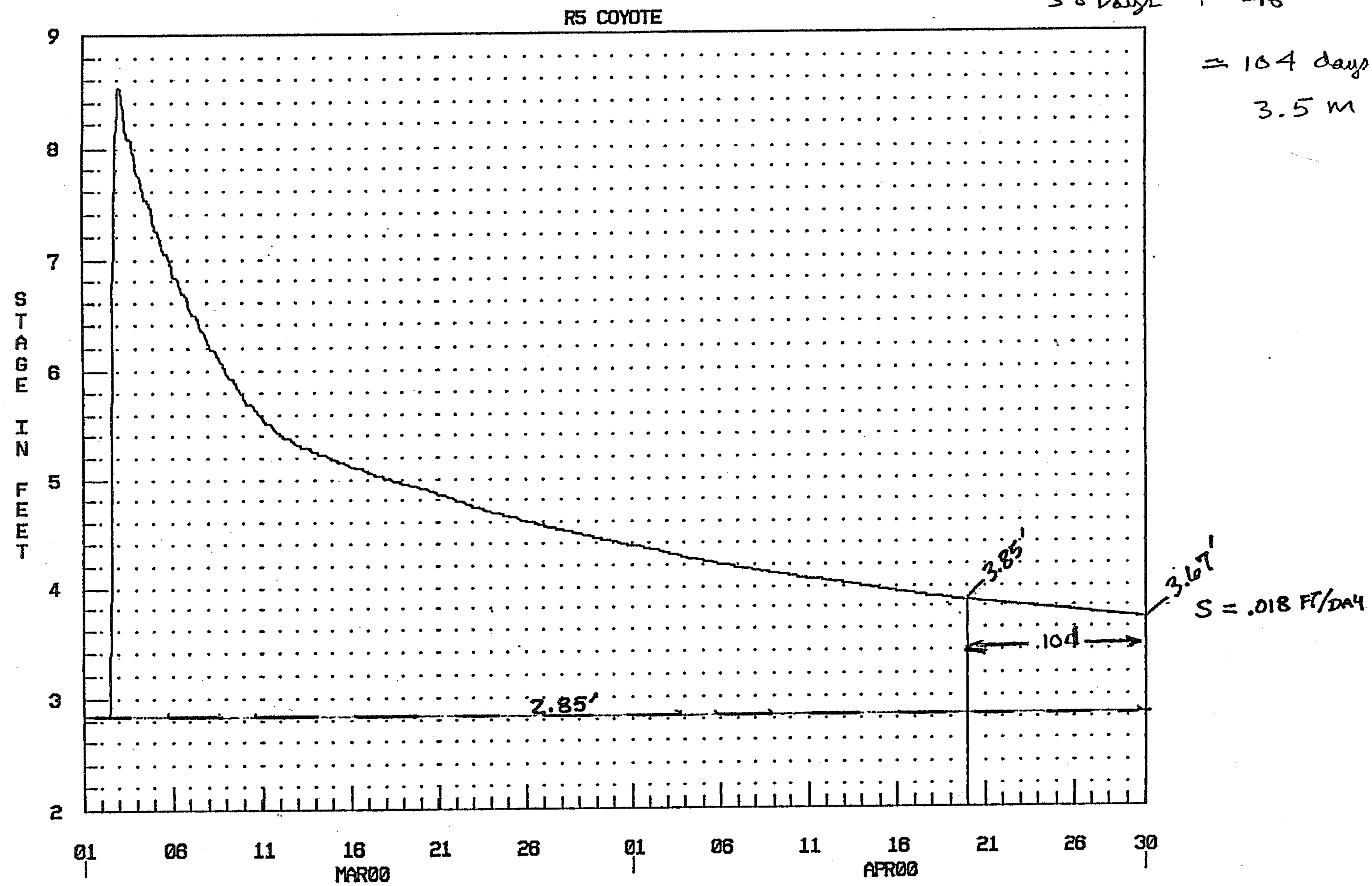


CARGILL A8W WITH LGR STAGE

$$\therefore \text{DAYS TO DRAIN (BEYOND APRIL)} = \frac{(3.34-0.53\ \text{FT})}{0.013\ \text{FT/DAY}} \cong 216 \text{ DAYS (PAST 30 APRIL)}$$

30 APRIL 2001

FIGURE Ⓑ



58 Days + 46

= 104 days

3.5 m

S = .018 FT/DAY

$\therefore$ DAYS TO DRAIN (BEYOND APRIL) $= \frac{(3.67-2.85 \text{ FT})}{.018 \text{ FT/DAY}} \cong 46$ DAYS (PAST 30 APR)

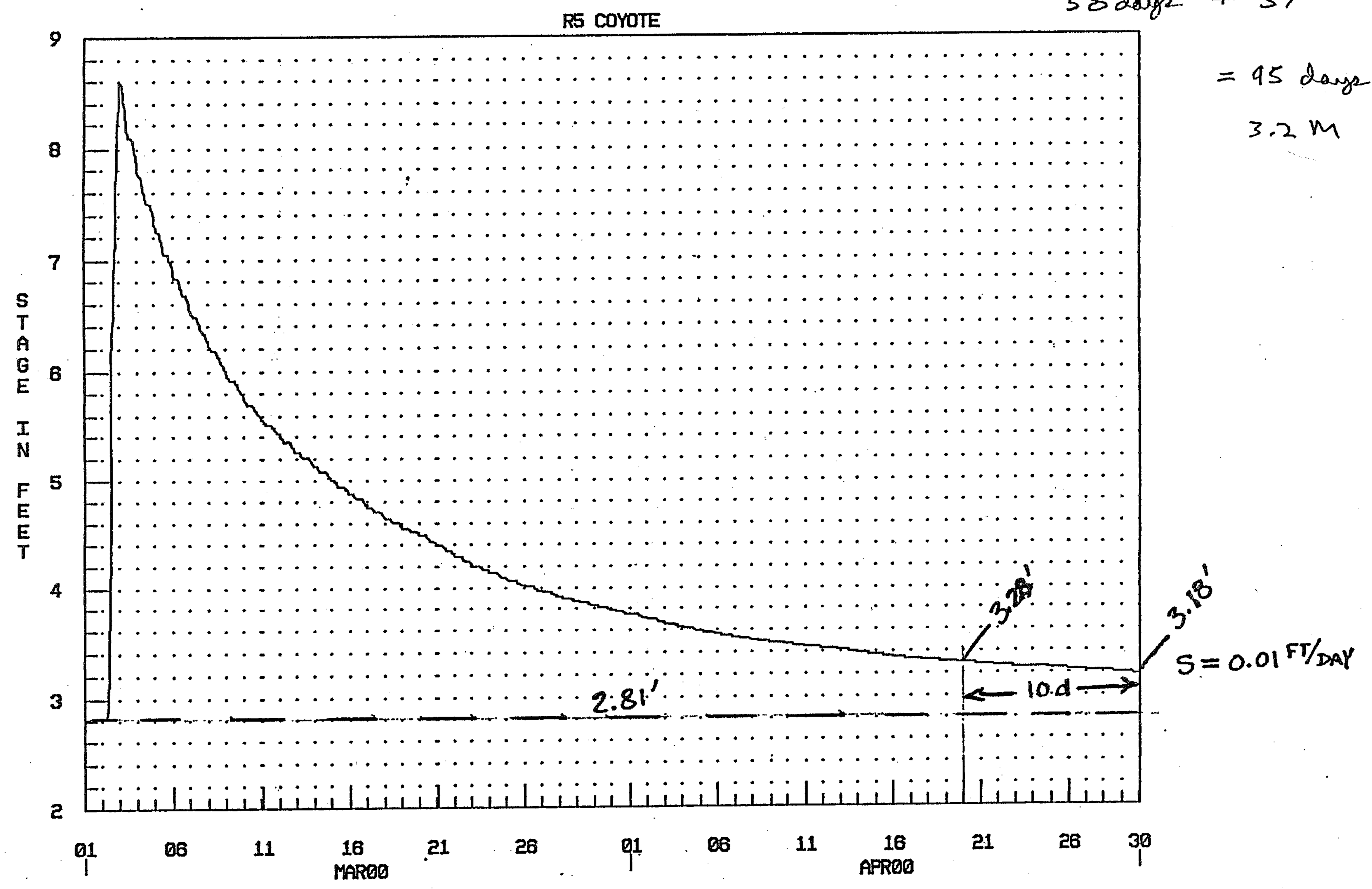
FIGURE Ⓒ

30 APRIL 2001

58 days + 37

= 95 days

3.2 M



CARGILL A7 WITH LGR STAGE

$$\therefore \text{DAYS TO DRAIN (BEYOND APRIL)} = \frac{(3.18 - 2.81 \text{ FT.})}{0.01 \text{ FT/DAY}} \cong 37 \text{ DAYS (PAST 30 APR)}$$

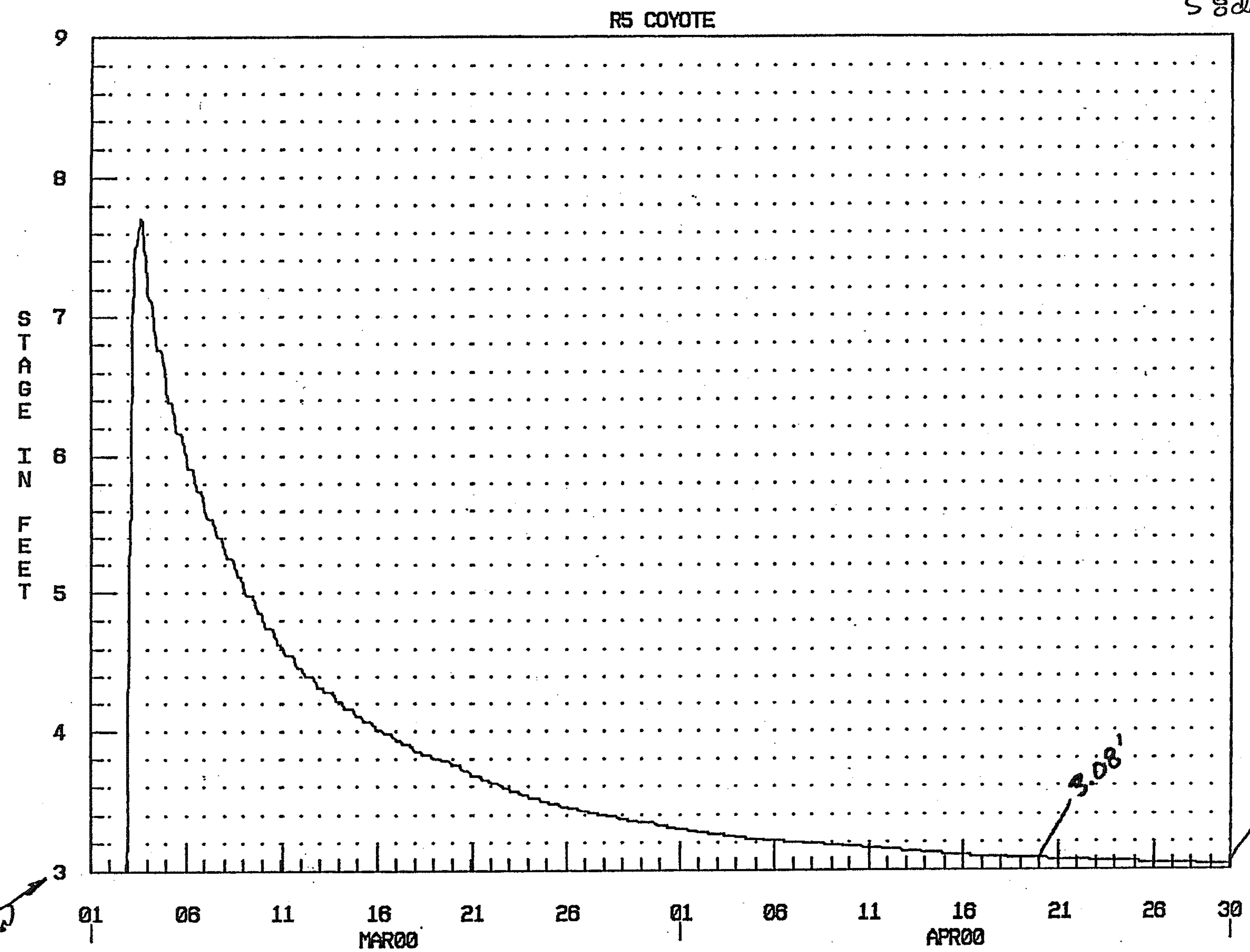
FIGURE Ⓓ

30 APR 2001

5 8 days + 10

= 68 days

2.3 M.



3.08'

3.04'

$S = 0.004 \ \text{FT/DAY}$

INITIAL (STARTING) ELEVATION

CARGILL A6 (FWS) WITH LGR STAGE

$\therefore$ DAYS TO DRAIN (PAST APRIL) $= \dfrac{(3.04 - 3.00 \ \text{FT})}{.004 \ \text{FT/DAY}} \cong$ 10 DAYS (PAST 30 APRIL)

30 APRIL 2001

FIGURE Ⓔ

TIDE STUFF

11 April 2001 **A2248/A2248a**

MEMORANDUM FOR RECORD

TO: David Von Rueden
CH2M Hill – San Jose Office

FROM: Loren Murray Loren A. Murray

Cc: Robert MacArthur
Jeff Johnson

SUBJECT: Lower Guadalupe River Flood Protection Project - Baylands: Review of Reconnaissance Study Tides for Hydraulic Analyses, Supplemental Assessment, nhc 50198.

Erika Gomez of your office contacted **nhc** requesting further definition of local tide effects on the downstream reaches of the LGRFPP project and vicinity. The following information summarizes our interpretation of readily available published tidal information for the Lower Guadalupe River and Alviso Slough area:

- The following references apply to the tide stage discussion:
  (1) NOAA / NOS published data for Tide Station #9414551, Gold Street Bridge, Alviso Slough, February 1990.
  (2) U.S. Army Corps of Engineers San Francisco District, Tide Stage versus Frequency Study, October 1984
  (3) U.S. Army Corps of Engineers "CORPSCON" Datum Conversion Program, Version 5.11.05, Alexandrea, Virginia, September 1997.
- The tide stage relationship (in feet) for the eustatic tide at the Gold Street Bridge on Alviso Slough/Lower Guadalupe River, based on the 1960-1978 epoch(1):

Tide Stage	**MLLW Datum** *(Ref. 1)*	**NGVD29 Datum** *(Ref. 2)*	**NAVD88 Datum** *(Ref. 3)*
Mean Higher High Water (MHHW)	9.31 ft.	5.01 ft.	7.71 ft.
Mean High Water (MHW)	8.70 ft.	4.40 ft.	7.10 ft.
Mean Tide Level (MTL)	4.95 ft.	0.65 ft.	3.35 ft.
Mean Low Water (MLW)	1.20 ft.	-3.10 ft.	-0.40 ft.
Mean Lower Low Water (MLLW)	0.00 ft.	-4.30 ft.	-1.60 ft.

(1) NOAA/NOS has not prepared any information on more recent epochs; these tide stage elevations exclude the effects on water surface from any discharge in the Lower Guadalupe River (i.e. – LGR flows = 0 cfs)., storm surge, low barometric pressure, winds, or winter high flow conditions in the bay.

- Datum conversions are: (1) NGVD29 = MLLW – 4.30 ft.;
  (2) NAVD88 = NGVD29 + 2.70 ft.

- According to Ref. 2 above, the tide stages vs. frequencies at Gold Street are:

10-Yr Tide:	11.8' MLLW	7.60' NGVD29	10.30' NAVD88
100-Yr Tide:	12.3' MLLW	8.10' NGVD29	10.80' NAVD88
500-Yr Tide:	12.60' MLLW	8.30' NGVD29	11.00' NAVD88

These tide stages are as of 1984, and do not account for published S.F. bay regional sea level rise between then and the present, equivalent to approximately .677 ft (~8 in.).

- Using a conversion from imperial units to metric (1200 ÷ 3937 = 0.3048 m/ft.):

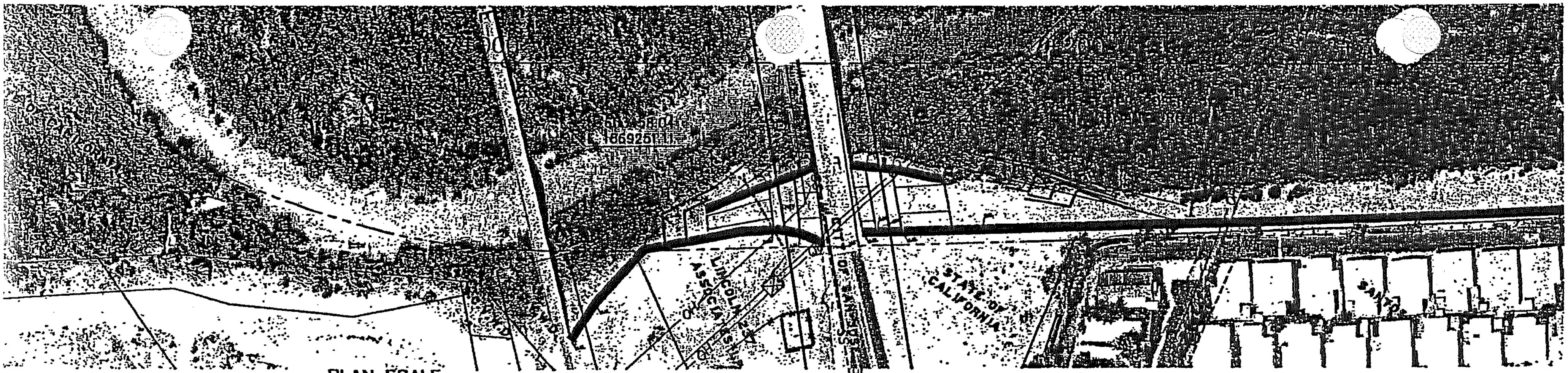
Alviso Slough at Gold Street* (NAVD88; meters)	
10-Year Tide:	3.14 m
MHHW:	2.35 m
MHW:	2.16 m
MTL:	1.02 m
MLW:	-0.12 m
MLLW:	-0.49 m

* These stages are based on 1984 sea levels, the 1960-1978 tidal epoch, and exclude any discharge occurring in the Guadalupe River.

A copy of part of Sheet 4 of 40 of the LGRFPP Draft Engineers Report has been marked up with these values and attached to this memorandum (hardcopy only; no electronic version available). It shows the relationship between these tide stages throughout the full tide cycle and planned maintenance access facilities. The lowest point of the maintenance crossing (as presently depicted) will be submerged for about 14-16 hours out of each 24-hr day as tides rise from mean low water up through mean tide to mean high water, and then back down again, twice daily.

- In March, Randy Talley submitted a sample tide data set collected by the District at Gold Street and requested that we review these data relative to the tidal hydraulic boundary conditions that we've employed on this project. Figure 1 (attached) shows the District's tide data for the month of January 1988 with the previously listed eustatic tide elevations also shown on the figure. In comparison, we have adjusted the NOAA tide station data to the NGVD29 geodetic datum (used in the District's data set) to show the association of the District's data to the historical published tide data for Gold Street Bridge at Alviso, California. The District's dataset is slightly higher, on the average, by about six-tenths of a foot (0.6'). This could be associated with discharge occurring in the Guadalupe River when the measurements were made, placement of the zero-elevation of the gage, low (winter season) air pressure in the region, storm surge, wind setup, or that comparison is being made between 1988 data against tide station data based on an earlier epoch (1960-1978). Future baylands studies will assess the applicability of the District's tide data as part of the hydraulic boundary conditions.

- Note: Eustatic MLW and MLLW tide elevations summarized here may be several feet lower than low tide elevations that actually occurred during winter high flow seasons.



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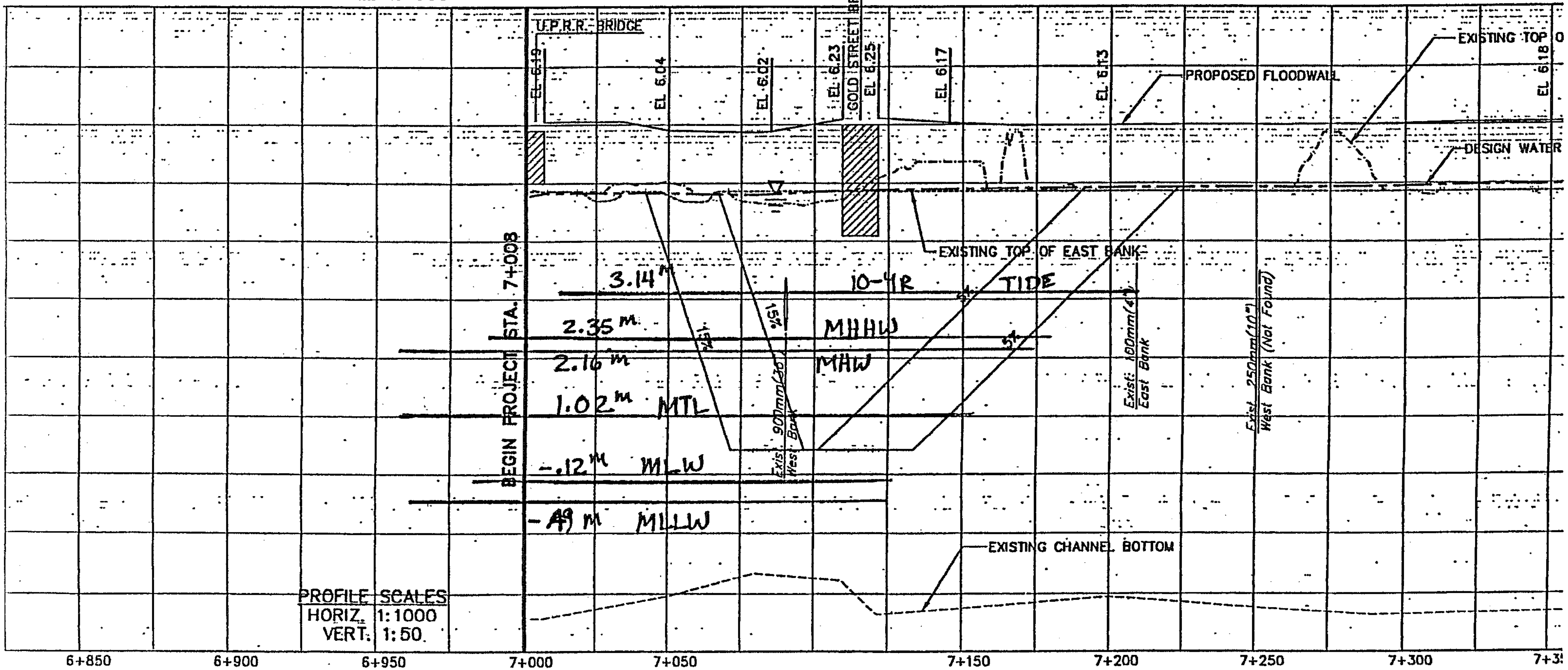

REFERENCE INFORMATION AND NOTES

1. WATER SURFACE ELEV. Q DESIGN = 481.4 cms (17,000 cfs)
2. FLOODWALLS TO BE ARCHITECTURALLY TREATED.
3. RIGHT-OF-WAY & PROPERTY LINES DERIVED FROM SANTA CLARA VALLEY WATER DISTRICT (SCVWD), RIGHT-OF-WAY DRAWINGS & PARCEL MAPS.
4. STORM DRAIN AND PUMP STATION OUTFALLS SHOWN ON PROFILE.
5. AERIAL PHOTOS TAKEN 08/20/1999.

CH2MHILL

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(408)436-4909

DATE	2/20/01
DESIGN	J.A.M
DRAWN	J.A.M.
CHECKED	

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

DATE

LOWER GUADA
FLOOD PROTEC
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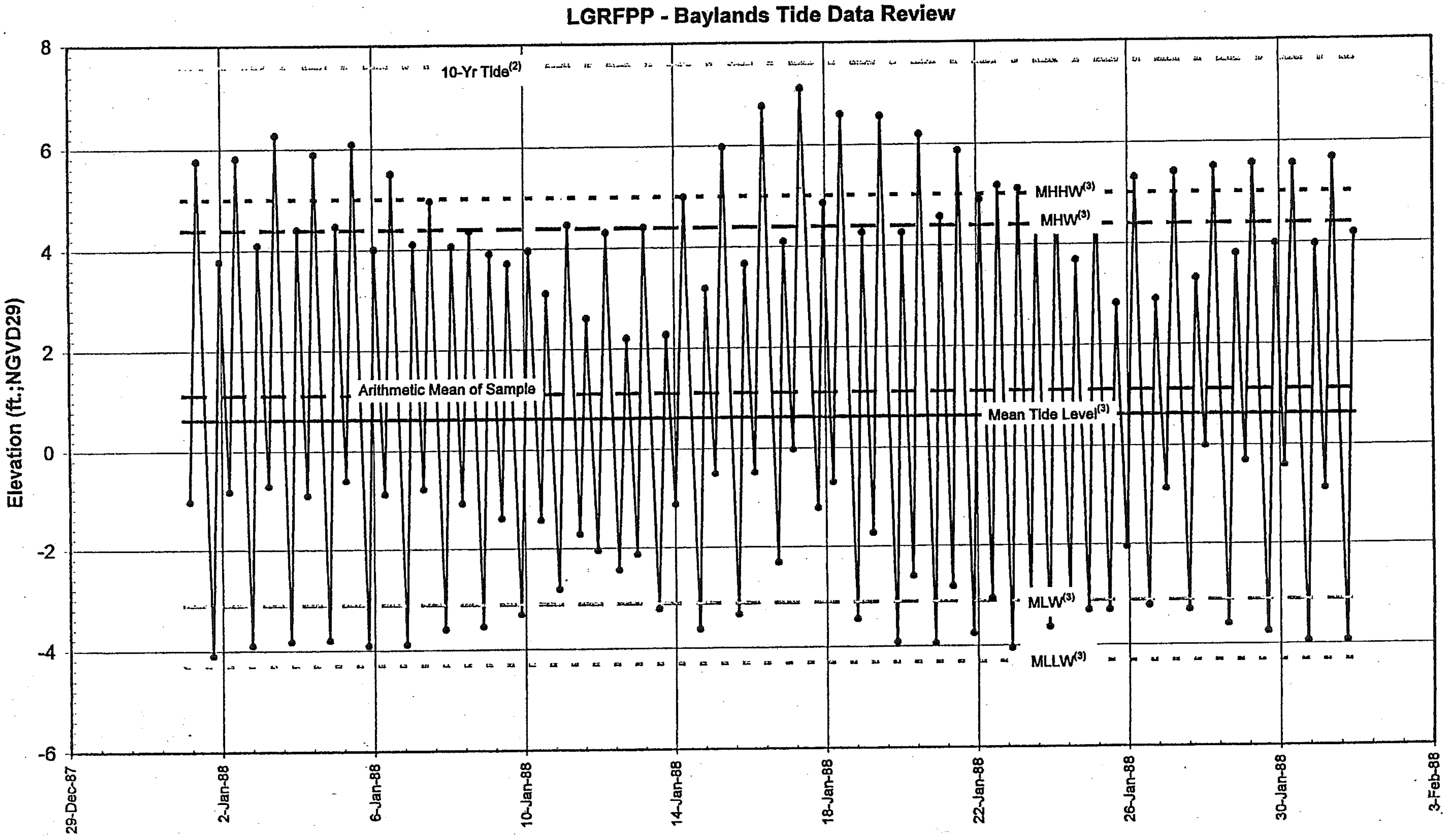
Apr-01 C:\Projects\50198\Corresp\[SCVWD-tidedata.xls]AlvisoSl Tab



FOOTNOTES:

(1) - Data provided by SCVWD (R.Talley) in Feb 2001.

(2) - U.S. Army Corps San Francisco District, Tide Stage vs. Frequency, October 1984.

(3) - NOAA Tide Station Data, Station 9414551, Eustatic tide as of 1984, 1960-1978 Epoch.

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Preliminary Review of Alviso Slough Tides at Gold Street Bridge
Lower Guadalupe River Flood Protection Project
Reconnaissance Study - UPRR to the Bay

FIGURE
1

COPY

27 February 2001 **A2248/A2248a - Task 10**

MEMORANDUM FOR RECORD

DRAFT

TO: David Von Rueden, CH2M Hill

FROM: Loren Murray, P.E., Bob MacArthur, P.E.

SUBJECT: Supplemental Baylands Incremental Analysis Results, nhc 50198

This memorandum summarizes the results from the most recent baylands incremental analyses prescribed in the 19 January 2001 memorandum authorized by CH2M Hill email on 24 January 2001.

References:
The following previously submitted products are pertinent background information to this memorandum:

1. Memorandum from NHC to CH2M Hill dated 11 December 2000, Subject: *"Supplemental Baylands Incremental Analysis Results, nhc 50198"*;
2. Memorandum from NHC to CH2M Hill dated 23 Oct 2000, rev. 13 Nov 2000; Subject: "*Incremental Baylands Reconnaissance Results*";
3. Memorandum from NHC to CH2M Hill dated 23 Oct 2000, Subject: "*Incremental Baylands Reconnaissance Results*";
4. Draft Reconnaissance Report, *"Engineering and Environmental Reconnaissance Studies of the River Reach from UPRR to the Bay, Lower Guadalupe River,"* June 2000.

Purpose:

At a meeting with the District and CH2M Hill on 17 January 2001, **nhc** received additional instructions to perform additional hydraulic analyses to support the assessment and reporting of environmental impacts for the Administrative Draft EIR/EIS. Specific new tasks included:

1. Quantifying the duration of inundation of the baylands study area under present-day, existing conditions (now defined as the14,000 cfs maximum discharge event from Lower Guadalupe River into Alviso Slough);
2. Modifying the UNET model to reflect the recent refinements and new locations of the gravity drain outlets from ponds A-5 to A-8, including the USFWS Refuge. Previous reconnaissance analyses had all the outlets located in the Refuge;
3. Re-assessing the hydraulics of the baylands study area with the revised gravity drain configuration and a new 4-day design discharge hydrograph on the Lower Guadalupe River of 17,000 cfs (at UPRR). Analyses includes peak stage and approximate depths of flooding at key locations. The new analyses will also determine the approximate duration of

inundation within ponds A-5 through A-8.

4. Updating existing conditions (14,000 cfs LGR flows) and with-project (17,000 cfs LGR flows) water surface profiles for both Alviso and Guadalupe Sloughs to be used in assessing inundation impacts to wildlife habitat along these sloughs;
5. Incorporating new CH2Mhill top of levee surveys to evaluate the flood risk to Alviso over the low, non-engineered levees running north of Alviso ("Alviso North Levee") from the County Marina northward to Triangle Marsh, and identify (at a recon-level) the needs for levee improvements to protect Alviso from Guadalupe River-Only flood risks;
6. Writing a technical memorandum to document NHC's analyses and results.

Results:

1. ***Existing Conditions Inundation Duration:*** *Criteria, Assumptions and Boundary Conditions* This assessment included regional 100-year events on the Coyote Creek, Guadalupe River, and Guadalupe Slough watersheds. The tide boundary condition is assumed to be a 10-year tide without consideration for anticipated sea-level rise. On Guadalupe River, a maximum discharge of only 14,000 cfs reaches Alviso Slough due to channel capacity constraints upstream of the UPRR Trestle crossing. This scenario retains the existing left bank, un-engineered Alviso Slough levee overtopping geometry ~~across~~ from the town of Alviso into Cargill Pond A8. This scenario also excludes the gravity drain outlet improvements to Ponds A5-A8. It is assumed that all the non-engineered levees remain intact (no failures) throughout the passage of the storm hydrographs, and that no baylands mitigation components have been implemented. It is assumed that Ponds A5-A8 will be drained by evaporation processes only, and that the 14K cfs flood event inundating the study area occurs at the beginning of January, with no antecedent flooding into the ponds prior to the event.

   Results – Following a four-day flood event, flooding occurred in Cargill Ponds A5, A7, A8W, A8D and A3 from flows leaving Alviso Slough over the present low weir at pond A-8W. The duration of flooding was determined by estimating the monthly evaporation and precipitation rates over the course of a year starting in January. Table 1 shows change in flood depths for the impacted areas on a monthly basis. In summary, under existing (no improvements) conditions evaporation alone is not capable of removing the floodwaters associated with a 4-day 14,000 cfs flood event. In order to drain the ponds to pre-storm conditions, auxiliary pumping will be necessary.

2. ***Relocation of Mitigation Plan Outlet Components:*** *Criteria, Assumptions and Boundary Conditions* – The previous "With-mitigation plan" UNET model was modified in order to locate gravity drains in Ponds A-5 through A-8 and the Refuge area in such a way as to maximize gravity drainage potential and minimize disturbance to existing habitat along the Alviso and Guadalupe Sloughs (see Figure 1).

3. ***With-Design Hydraulic Analysis:*** *Criteria, Assumptions and Boundary Conditions* – Key assumptions and boundary conditions associated with this assessment including: a) an engineered overflow from Alviso Slough into Cargill Pond A8W, b) improvements to the County Marina and levees to eliminate Alviso Slough overtopping into Alviso, CA., c) engineered outlets identified and located in Figure 1, and d) the authority to construct project improvements within ponds A5 through A8 and to be able to flood Cargill Ponds A5, A7, A8W and A8D, and the USFWS Refuge to greater depths, with greater durations. The new outlets are placed with their invert elevations set at existing salt pond operation water surfaces (for the wet cells A5, A7 & A8W) or ground invert for dry areas (A8D and the Refuge). The hydraulic conditions include: a) a 10-year tide condition in the South Bay excluding anticipated sea-level rise over the project life, b) 100-year events on Coyote Creek (with proper phase lag), Guadalupe River and Guadalupe Slough watersheds, and c) a maximum discharge of 17,000 cfs during the new 4-day design event from Lower Guadalupe River to Alviso Slough. It is assumed that all the non-engineered levees remain intact with no failures, even during overtopping throughout the passage of the storm hydrograph.

   Results – The results indicated that the ponds can not completely drain back to pre-storm conditions with gravity drains alone within a reasonable period of time. Figure 2 shows the water surface elevations in the ponds during and after the new design storm has passed, and indicates the approximate depths of inundation following such an event. Results from the inundation-duration analysis show that auxiliary pumping will be required to return the ponds to pre-flood conditions depending on the period deemed allowable by the resource agencies for inundation. It is important to also consider the need to evacuate these ponds of flood waters quickly so as to prepare them to store excess flows from the likely occurrence of nested storm events. [The effects of cumulative loss of storage from nested storm events has not been evaluated, but is an important consideration for future design and operation of the pond and pumping program for the Baylands area.]

   Figures A5, A6-A, A6-G, A7, A8D and A8W show hydraulic conditions at the various outfall locations. Results in the ponds show conditions immediately following the 4-day design event, whereas the conditions depicted in the sloughs are thecomputed maximum water surfaces occurring during the 4-day event. These figures show existing conditions (14k cfs from LGR) versus design event conditions (17k cfs from LGR) and both assume a hypothetical design storm hydrograph with only a 4-day duration. [Future planning and design analyses should evaluate conditions during possible 7-day, 15-day or longer flood events.]

   Gravity drainage of the impacted salt ponds cannot occur within a reasonable amount of time without pumping assistance. Therefore, auxiliary pumping will be required if the affected ponds need to be returned to pre-storm conditions in a shorter period of time (less than ??? days - to be set by the District, Cargill and the resource agencies). For this analysis, it was determined that gravity drainage is effective for about 16 days at which drained by gravity alone diminishes until base flows in the streams return to very low flowrates and low tide conditions (the time period is unknown, but likely to be months during the wet season). Thus, the pond drainage scenario analyzed uses gravity drainage for 16 days following the 4-day storm, followed by auxiliary pumping to show a more reasonable range of expected inundation durations conditions, e.g. gravity drainage combined with pumping.

Since both existing conditions (14k cfs from LGR) and design event conditions (17k cfs from LGR) require pumping, a range of pumping rates were evaluated. It was assumed that 14 days were required (following a 4-day storm event) to bring in, setup and start operation of portable pump stations for the existing conditions scenario (at present, these pump stations do not exist). For both existing and design event conditions, one pump of a rated discharge was allocated to each flooded pond. Hence, four pumps were used under existing conditions to evacuate ponds A5, A7, A8D and A8W, and five were used for with-design conditions to evacuate A5, A7, A8D, A8W and the USFWS Refuge. Figure 3 shows the duration (in days) to return the impacted areas to pre-storm conditions for both the existing conditions scenario as well as the with-design conditions. Even with a pumping regiment utilizing five (5) 100-cfs pumps running continuously 24 hours/day (assumes that power, fuel, etc. are available), the time necessary to evacuate the impacted ponds to pre-storm conditions is between one to four weeks, depending on the pond (see Figure 3).

4. ***Water Surface Profiles for Alviso and Guadalupe Sloughs: Criteria, Assumptions and** Boundary Conditions* –Maximum water surface profiles for Alviso and Guadalupe Sloughs were developed with UNET for both existing conditions (14,000 cfs from LGR into Alviso Slough), and design conditions (17,000 cfs from LGR into Alviso Slough). Geometry used to depict the topography is based on available existing data only (future validation and refinement of these data are necessary), which ranges from 2-25 years old. The 10-year tide is used as the downstream hydraulic boundary condition with no correction for future anticipated sea-level rise. The orientation of the profiles are based on standard convention of facing downstream when referring to "left" or "right" features.

   Results – *Alviso Slough:* The water surface profiles for Alviso Slough show an average increase in depth of about one foot between the existing conditions (14,000 cfs) and the with-project design conditions (17,000 cfs) as is shown in Figure 4. The in-channel vegetated banklines are inundated by about 4-5 feet for the duration of either of the storm events. (The location of the overtopping swale to Cargill Pond A8W is at approximately Mile 4.2.) *[Please note: if pumping occurs into the Guadalupe River upstream of Alviso, the peak flow and resulting maximum water surface profile elevations may increase above these values.]*

   Guadalupe Slough: The existing versus design water surface profiles are the same for Guadalupe Slough since the hydraulic boundary conditions for both scenarios are the same (1-percent events on San Tomas Acquino, Calabazas, Sunnyvale East, and Sunnyvale West Creeks with the same tidal boundary condition). Figure 5 show the water surface profiles relative to in-channel vegetated overbank areas as well as levee crown profiles for the Guadalupe Slough. Caution is warranted when reviewing these results since much of the geometric data used in the Guadalupe Slough hydraulic assessment is up to 25 years old and may have been affected by levee settlement, O&M operations, dredging and tidal sedimentation processes.

5. *Flood Risk to Alviso From Levee Overtopping of the Alviso North Levee: Criteria, Assumptions and Boundary Conditions* – This assessment investigates with-project hydraulic conditions including a) a 10-year tide condition in the South Bay, b) 100-year events on

Coyote Creek, Guadalupe River and Guadalupe Slough watersheds, and c) a 4-day design flood with a maximum discharge from Lower Guadalupe River to Alviso Slough of 17,000 cfs. During an event of this nature there is risk of flooding from the Guadalupe River to Alviso due to Guadalupe River floodwaters overtopping the right bank levees of Alviso Slough and flowing through ponds A12, A13 and A15 to the east and flowing back into Alviso through the New Chicago Marsh area by overtopping the eastern levees in Ponds A12, A13 and A15. Figure 6 shows these results. Notice that for the 17,000 cfs design event, that there is only a small change in water surface depths due to levee overtopping flows entering pond A12. One could easily misinterpret this result to mean that there is little risk of overtopping from Guadalupe River flows getting into Alviso. It turns out that the peak 17,000 cfs flow is enough to overtop the right bank levee of Alviso Slough in several places. However, our present assumptions that all of the Cargill levees will remain stable and unaffected by high flows and even overtopping, prevents the likelihood of greater flows leaving Alviso Slough. It is our professional opinion that at a minimum, some amount of levee erosion would occur on these unprotected levees during an overtopping event. Therefore, to show the potential effects of only one relatively small isolated overtopping erosion site on increasing the potential for flooding into Alviso, we assumed that a small localized low spot where Alviso Slough presently overtops into Cargill Pond A12 to the north. We assumed a single levee erosion site approximately 350 linear feet wide that would erode the crown of the levee down approximately 4 feet from its present top-of-levee elevation as shown in Figure 7. This conservative (on the small side) depicts the effects of a single erosion overtopping site and provides very plausible results from such an occurrence at only one location. Figure 8 shows the results of this scenario during the 4-day 17,000 design event.

Results – Figure 8 shows how significant such an event (a small single erosion incision on the Right bank Alviso Slough levee) is on flooding depths in ponds A11, A12, A13 and A15 and on the flooding depths in the City of Alviso. Cargill ponds A11 – A15 are flooded to an elevation of approximately 10 feet which is approximately 4 to 7 feet above their initial operating water surface elevation prior to the event, depending on the pond. Alviso and Rincon De Los Esteros and the New Chicago Marsh are flooded to a depth of approximately 8.2 feet (Figure 8). NHC has not attempted to determine the duration of flooding to any of these areas. These results show how important the stable-levee assumption is. If we determine during future geotechnical evaluations that the present-day Cargill levees are likely to erode, or even breach, then the risk of flooding from Guadalupe River high flows is even more significant than we present show. If a levee were to breach quickly during the design event, there would be very little (if any) warning and time to respond. NHC, therefore, recommends further discussion and possibly more thorough hydraulic analyses of these types of levee instability scenarios.

Summary of Results: Refer to Results 1 through 5 stated above.

Conclusions and Recommendations:

- For existing conditions, increasing peak flows to the Baylands area from 14,000 to 17,000 cfs increases the depths and duration of flooding in ponds A5 through A8. An important impact of increasing the design flows from 14,000 to 17,000 cfs is that the USFWS refuge area will get flooded during the 17,000 cfs event, where it had not flooded during the 14,000 cfs event (based on available topographic information).
- With conceptual LGR mitigation components in place the depths of pond flooding are still slightly greater from the 17,000 cfs event than the depths of flooding for existing conditions (no improvements) and 14,000 cfs.
- With conceptual LGR mitigation components in place the 17,000 cfs event may cause slightly longer duration of flooding in the ponds than the duration of flooding from the 14,000 cfs event, depending on the pumping assumptions that are made for existing and with-project conditions (see Figure 3).
- An acceptable pond flooding duration period needs to be determined with consensus from the District, Cargill and the resources agencies. This criteria will set the target gravity drain and pumping design criteria needed for the mitigation project planning and design.
- The Alviso north levee mitigation feature can not be designed or built with these recon-level results. More detailed data and long-term simulations, including the analysis of nested storm events and levee stability analyses are necessary to adequately understand the needs and design characteristics for this feature.
- Need to determine appropriate extended period of base flow conditions to use for design analysis. This information is not presently available.
- Nested events and cumulative antecedent flooding conditions could likely induce flooding to ponds A12-A15 due to lack of capacity in A5-A8 to store or convey big events, and thus Alviso is likely to be at higher risk of flooding from Guadalupe River than we can presently predict. This recent result merits additional hydraulic and environmental analyses.
- Important to evaluate design events with longer duration and volumes during future planning and design (e.g., evaluate effects of 7-day, 15-day, 30-day event scenarios). Volume from these events may be more important than the short duration peak flow limited to 17,000 cfs.
- Important to determine whether Cargill and USFWS will allow project construction and the associated flooding conditions resulting from the LGR project. Also important to estimate the amount and costs for mitigating any construction and flooding impacts to the Baylands, including ponds A11 – A15.
- It is important to determine detailed levee stability characteristics and conduct further hydraulic assessments of possible levee overtopping and failure scenarios if deemed necessary.
- Present assumptions assume no contributions from pumping to the design event's peak magnitude, volume or duration. Validity of this assumption needs to be verified (it is likely that some pumping may take place prior to and after the peak of the design event and it may affect the total flood volume and duration).

- Present assumptions regarding initial flood storage volumes available at the beginning of a design event merits further discussion and assessment. It is likely that the design event could occur after several smaller magnitude events that could decrease the available storage in Ponds A5 through A8. It is also possible the USFWS and Cargill (and SFO-type projects) are planning to fill and restore many of the baylands ponds to tidal salt marshes, thus dramatically changing our present hydraulic assumptions and future project performance (see Figure 9).

Table and Figures Referred to in the text

Are included on the following pages

Table 1

Existing Conditions (14,000 cfs in LGR at UPRR) Flood Depths in Ponds A5-A8

Monthly Change in Pond Depth due to Precipitation[1] and Evaporation[2] Only (ft)

(No Baylands Mitigation Components Installed to Aid Drainage of Ponds)

Pond	Existing Depth (ft)	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
A5	4.50	4.67	4.75	4.74	4.51	4.12	3.59	3.04	2.55	2.21	2.03	2.06	2.18
A7	4.50	4.67	4.75	4.74	4.51	4.12	3.59	3.04	2.55	2.21	2.03	2.06	2.18
A8D	4.50	4.67	4.75	4.74	4.51	4.12	3.59	3.04	2.55	2.21	2.03	2.06	2.18
A8W	7.40	7.57	7.65	7.64	7.41	7.02	6.49	5.94	5.45	5.11	4.93	4.96	5.08
A3	0.10	0.27	0.35	0.34	0.11	EMPTY	EMPTY	EMPTY	EMPTY	EMPTY	EMPTY	EMPTY	EMPTY

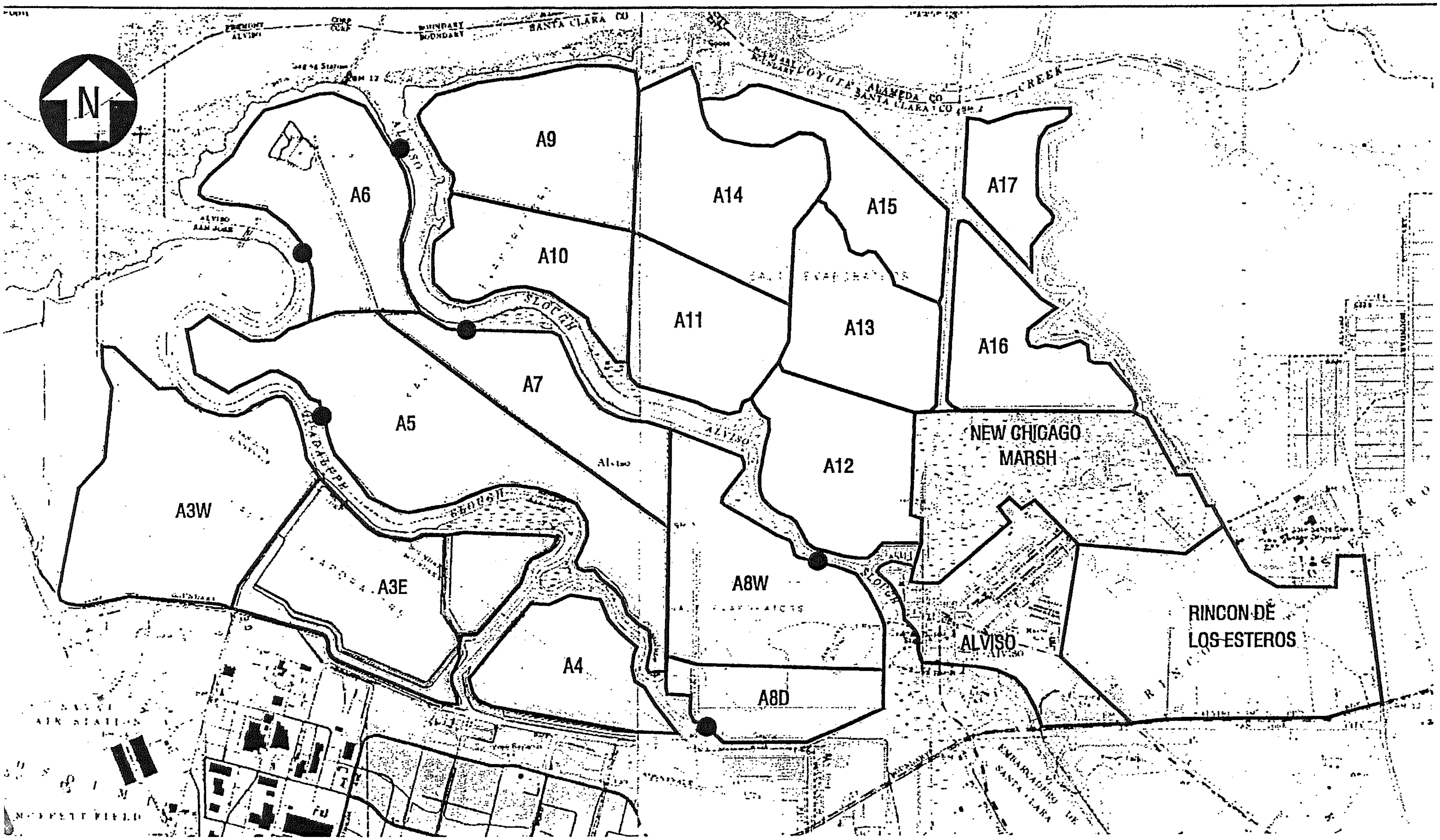
"Existing Depth" is the stormwater depth in the pond immediately after the design storm. This is the depth of the floodwaters only, not pre-storm salt brines.

[1] Data is based on monthly precipitation averages as recorded at the San Jose precipitation gage (1948-1995)

[2] Evaporation based Alamitos weather station evaporation pan data (October 1959 - July 2000)

Pump-out Assumptions:

1. Start Pumping in February (2-3 weeks after the event has past)
2. Starting depth includes precipitation for January and February



LEGEND

A7 CARGILL EVAPORATOR POND NO.

—— APPROXIMATE STORAGE CELL BOUNDARY

● APPROXIMATE STORAGE CELL OUTFALL CONDUIT

DRAFT as of
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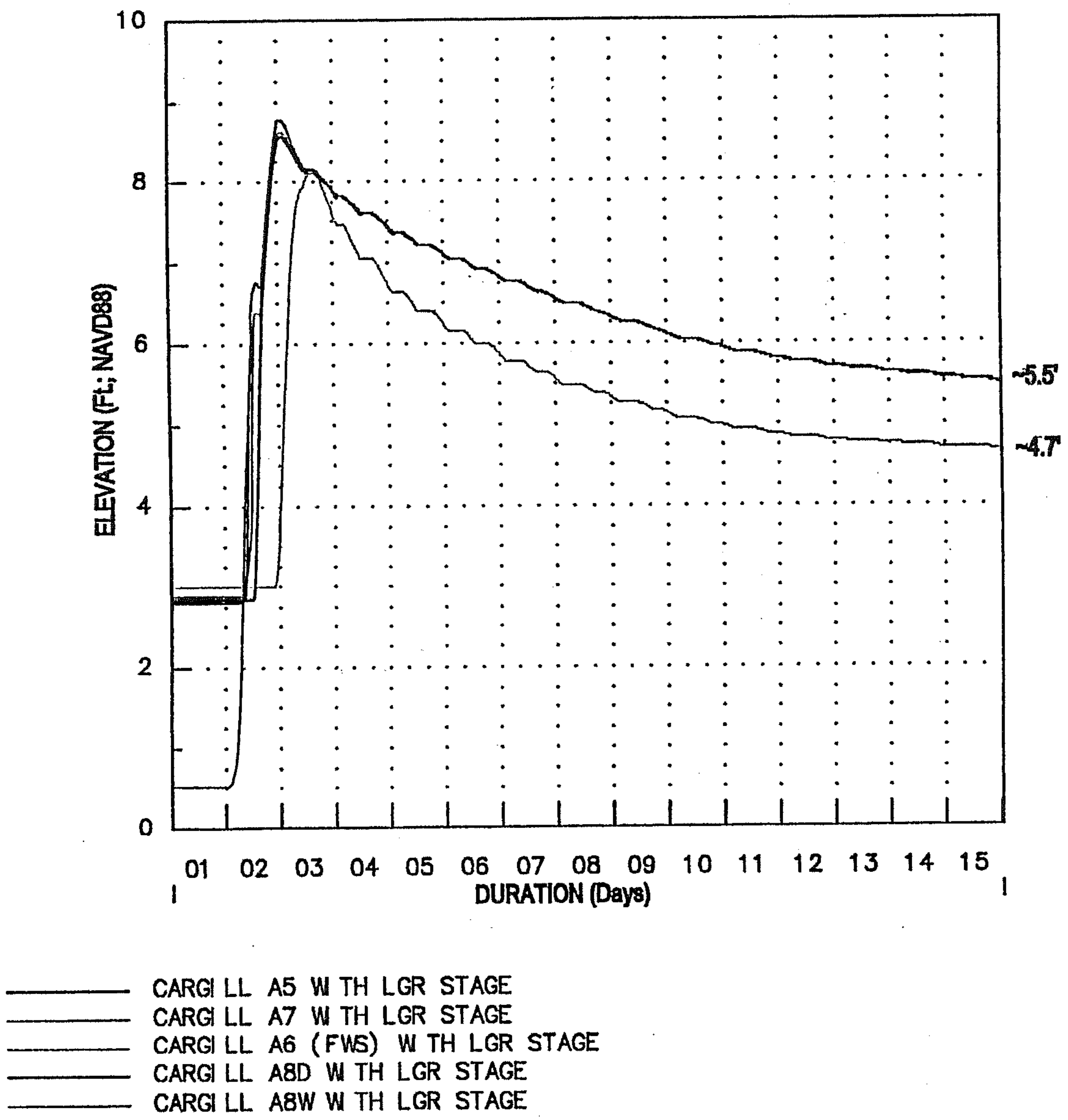
MITIGATION PLAN STORAGE CELL OUTLET LOCATIONS
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE
1



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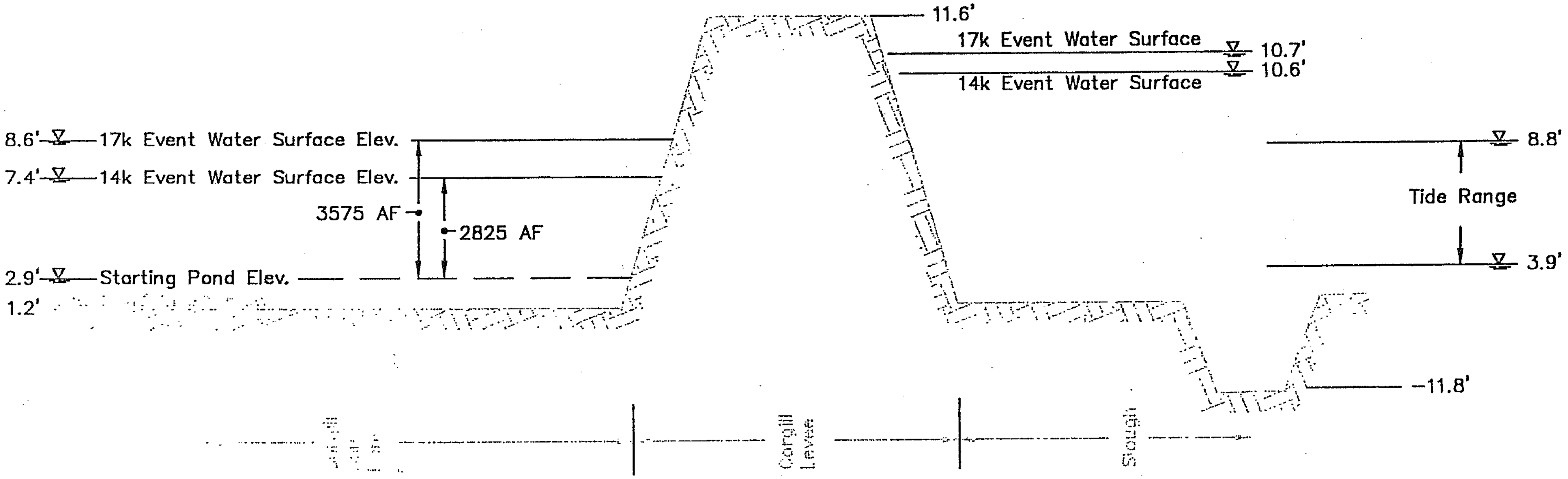
EXTENDED INUNDATION DURATION OF PONDS A5-A8
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE
2

CARGILL POND A5 AND GUADALUPE SLOUGH
NEAR A5's OUTFALL LOCATION



(MODEL SECTION 2.447)
Vertical Datum: NAVD88
GRAPHIC NOT TO SCALE

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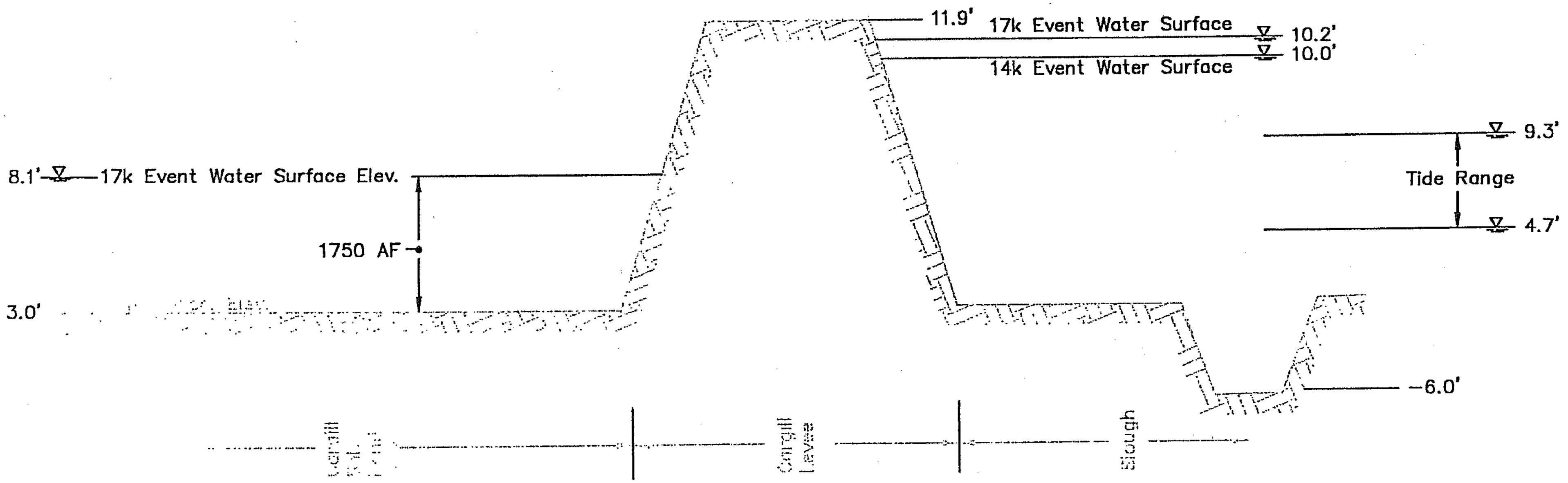
27 Feb 2001

CARGILL POND A5 HYDRAULIC CONDITIONS
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE
A5

CARGILL POND A6 AND ALVISO SLOUGH NEAR ONE OF A6's OUTFALL LOCATIONS



(MODEL SECTION 0.410)
Vertical Datum: NAVD88
GRAPHIC NOT TO SCALE

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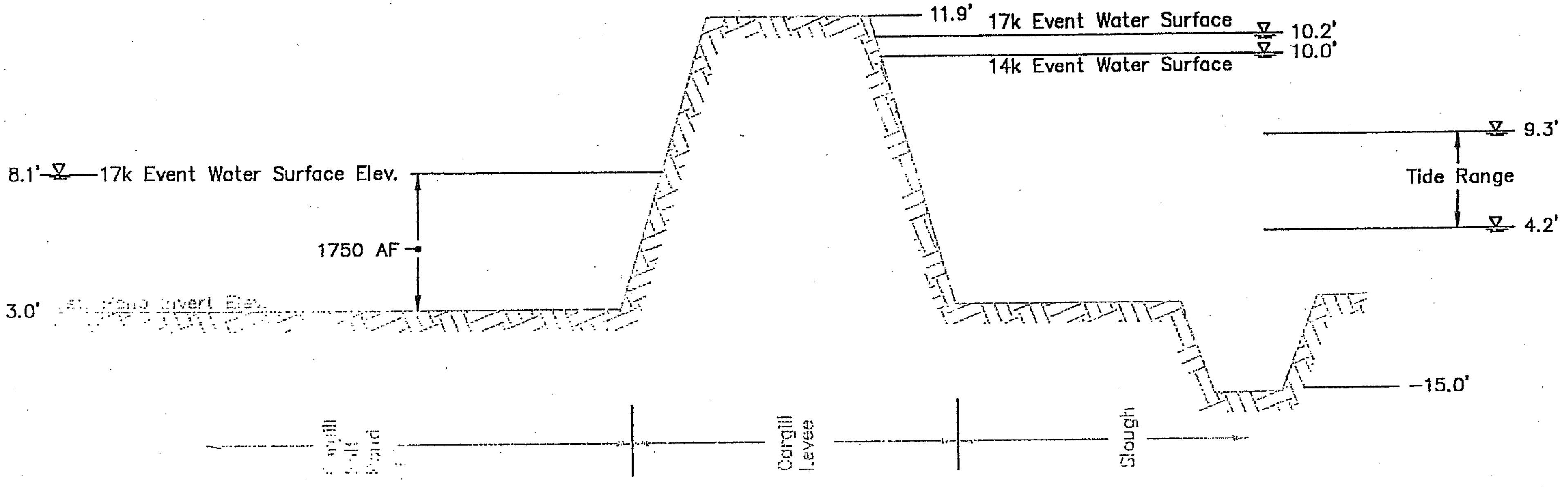
DRAFT as of
27 Feb 2001

USFWS REFUGE (A6) & ALVISO SLOUGH CONDITIONS
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE
A6-A

CARGILL POND A6 AND GUADALUPE SLOUGH NEAR ONE OF A6's OUTFALL LOCATIONS



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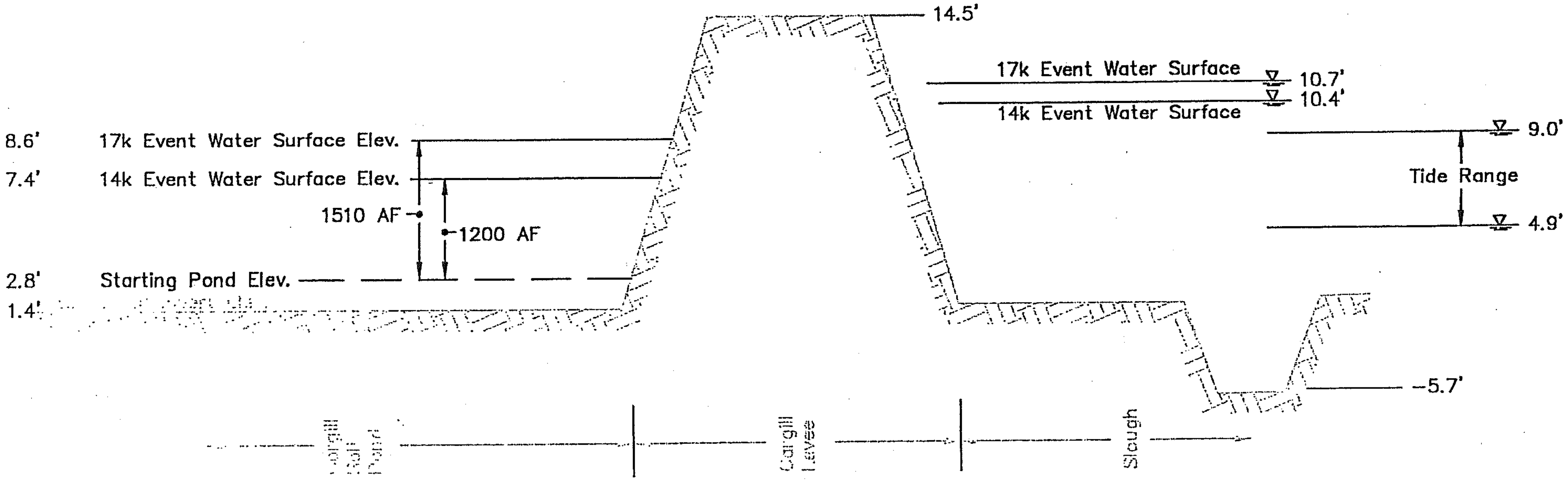
USFWS REFUGE (A6) & GUADALUPE SLOUGH CONDITIONS
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE
A6-G

CARGILL POND A7 AND ALVISO SLOUGH NEAR A7's OUTFALL LOCATION



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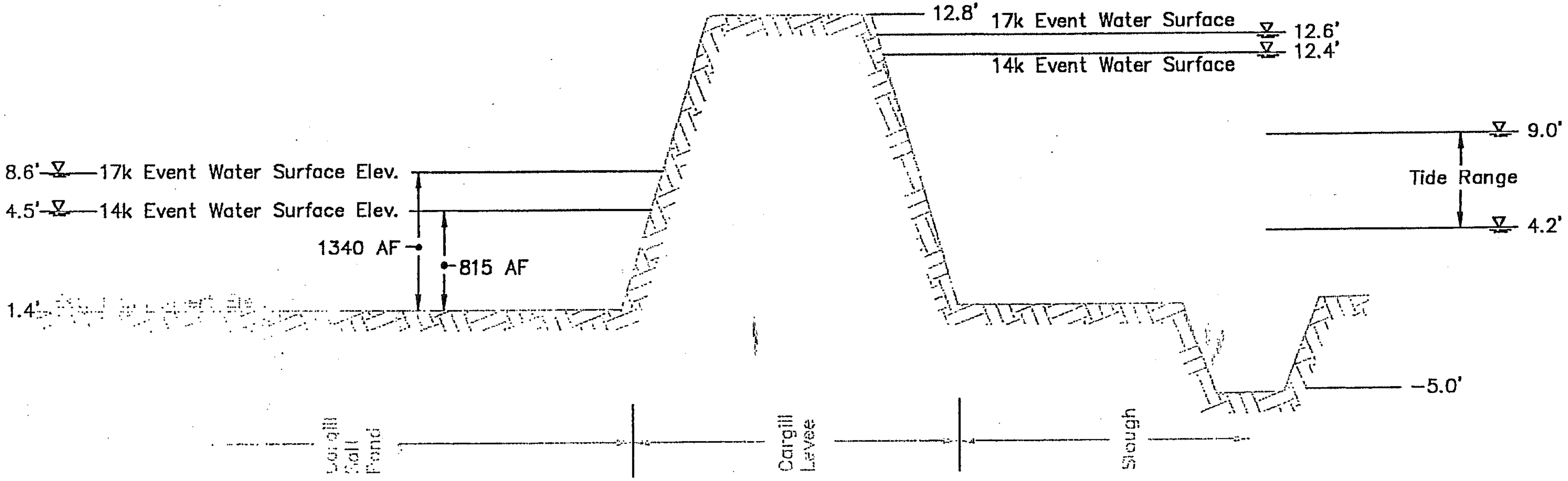
CARGILL POND A7 HYDRAULIC CONDITIONS
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE
A7

CARGILL POND A8(Dry) AND GUADALUPE SLOUGH
NEAR A8D's OUTFALL LOCATION



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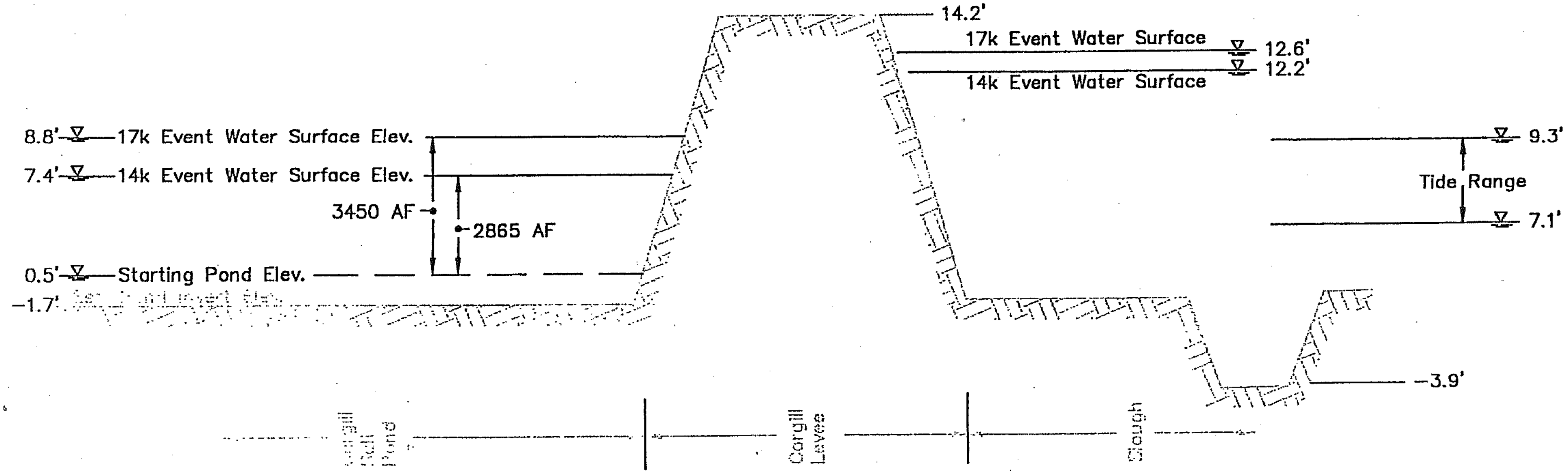
CARGILL POND A8(Dry) HYDRAULIC CONDITIONS
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE
A8D

CARGILL POND A8(Wet) AND ALVISO SLOUGH
NEAR A8W's OUTFALL LOCATION



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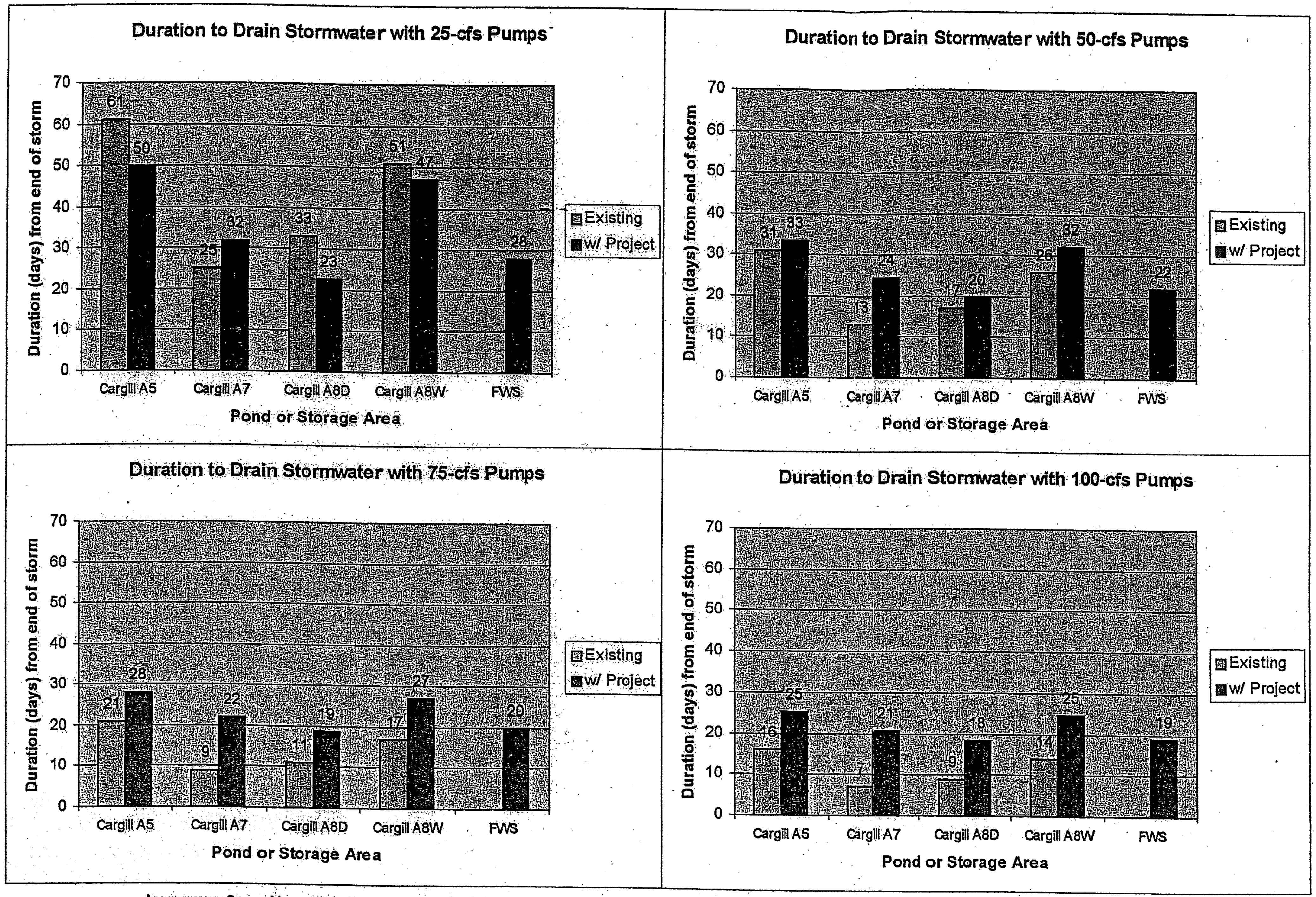
CARGILL POND A8(Wet) HYDRAULIC CONDITIONS
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE
A8W



RESULTS IN THIS FIGURE COMPARE TWO HYDRAULIC CONDITIONS:

Existing Conditions:

- 14,000 cfs in Guadalupe River at UPRR;
- Design Storm occurs in early January;
- No antecedent storm effects (no prior pond flooding);
- Evaporation alone cannot drain storm volumes, so pumping is required to drain ponds;
- Pumping initiated 14 days after end of 4-day storm event;
- Pump continuously until pre-storm water levels are restored in Cargill ponds A5, A7 and A8W, and A8D is drained completely.

With LGR, Baylands Mitigation and no Stormwater Pumping Into LGR:

- 17,000 cfs in Guadalupe River at UPRR;
- Design Storm occurs in early January;
- No antecedent storm effects (no prior pond flooding);
- Allow gravity drainage through pipe outlets for first 16 days, followed by continuous pumping (starting on day 17) until pre-storm water levels restored in Cargill ponds A5, A7 and A8W, and the Refuge and A8D are completely drained;
- Gravity drainage in baylands consists of one 8-foot diameter conduit with flap gate (one-way flow) for each pond A5, A7, A8W and A8D, and two 8-ft. dia. conduits for the USFWS Refuge (A6); all conduit inverts set at invert elevation for A8D and FWS Refuge, and pre-storm salt pond water surface elevations for A5, A7, and A8W.
- Gravity drainage alone, without subsequent pumping extends the duration period in A5, A7, A8W, A8D and the Refuge to more than a year.

APPROXIMATE STORM VOLUME** IN EACH POND TO BE DRAINED

Pond No.:	Existing Conditions:		With Lower Guadalupe River Project:	
Cargill A5	2,980	AF	3,605	AF
Cargill A7	1,235	AF	1,515	AF
Cargill A8D	860	AF	1,070	AF
Cargill A8W	3,175	AF	3,445	AF
FWS Refuge (A6)	0	AF	2,950	AF

** Volume includes mean monthly precipitation.

C:\Projects\50198 - LGR\Calcs\DurationFigure.doc

LEGEND:

"Existing"	Present-day conditions (e.g.-no baylands improvements) and assuming 14000 cfs can get to UPRR trestle at Alviso, California.
"With-Project"	Lower Guadalupe River Project completed to deliver 17000 cfs to UPRR trestle at Alviso, California, with no additional flow in LGR from local stormwater pumping.
"Duration"	The time necessary to drain all the ponds back to their pre-flood elevations for a range of pumping rates. Each of the five pond areas will have one pump with the stated capacity.

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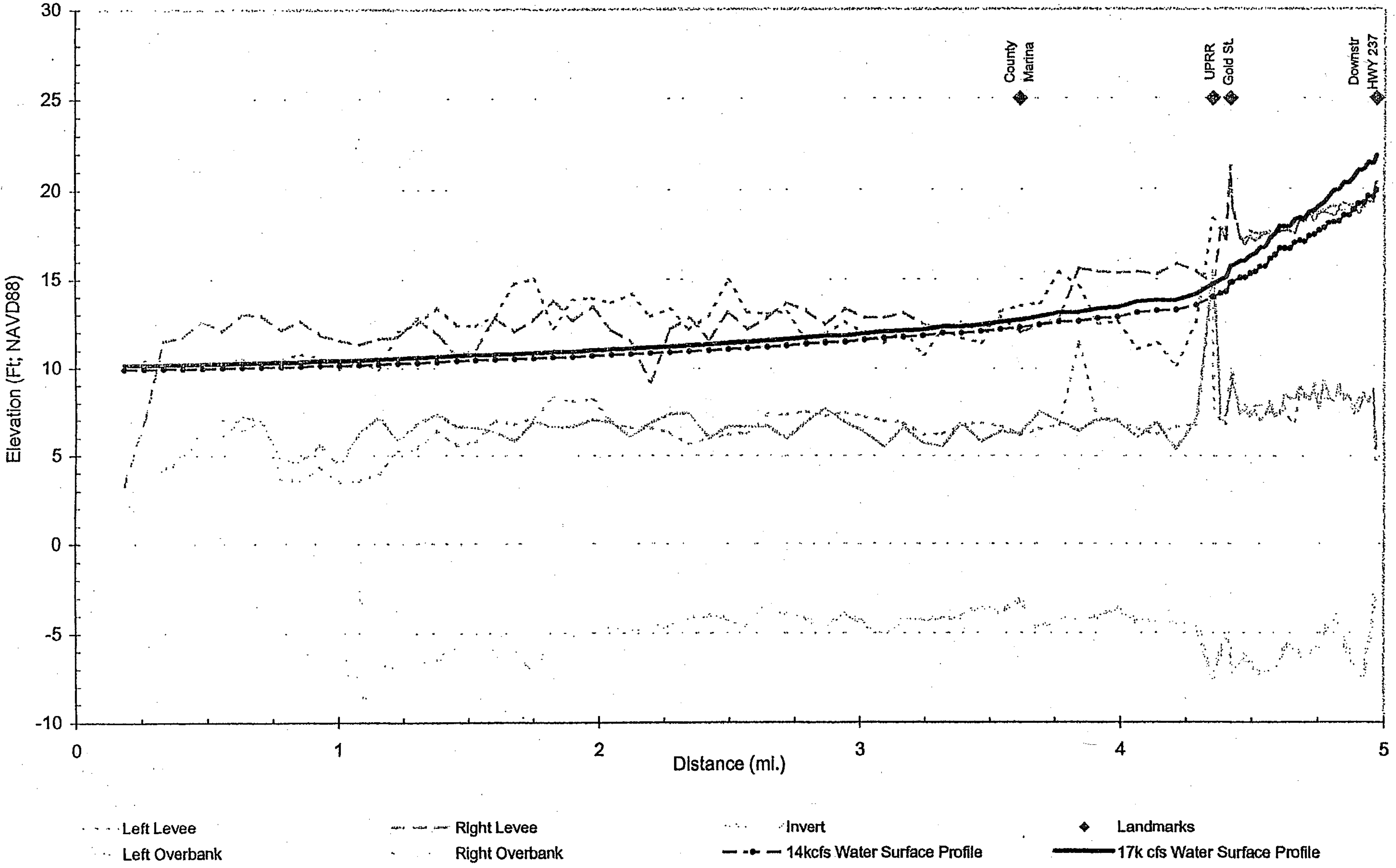
APPROXIMATE VOLUME AND DURATION OF FLOODING IN SALT PONDS A5-A8
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE
3

C:\Projects\50198 - LGR\Calcs\[leveeprofs.xls]Alviso Slough



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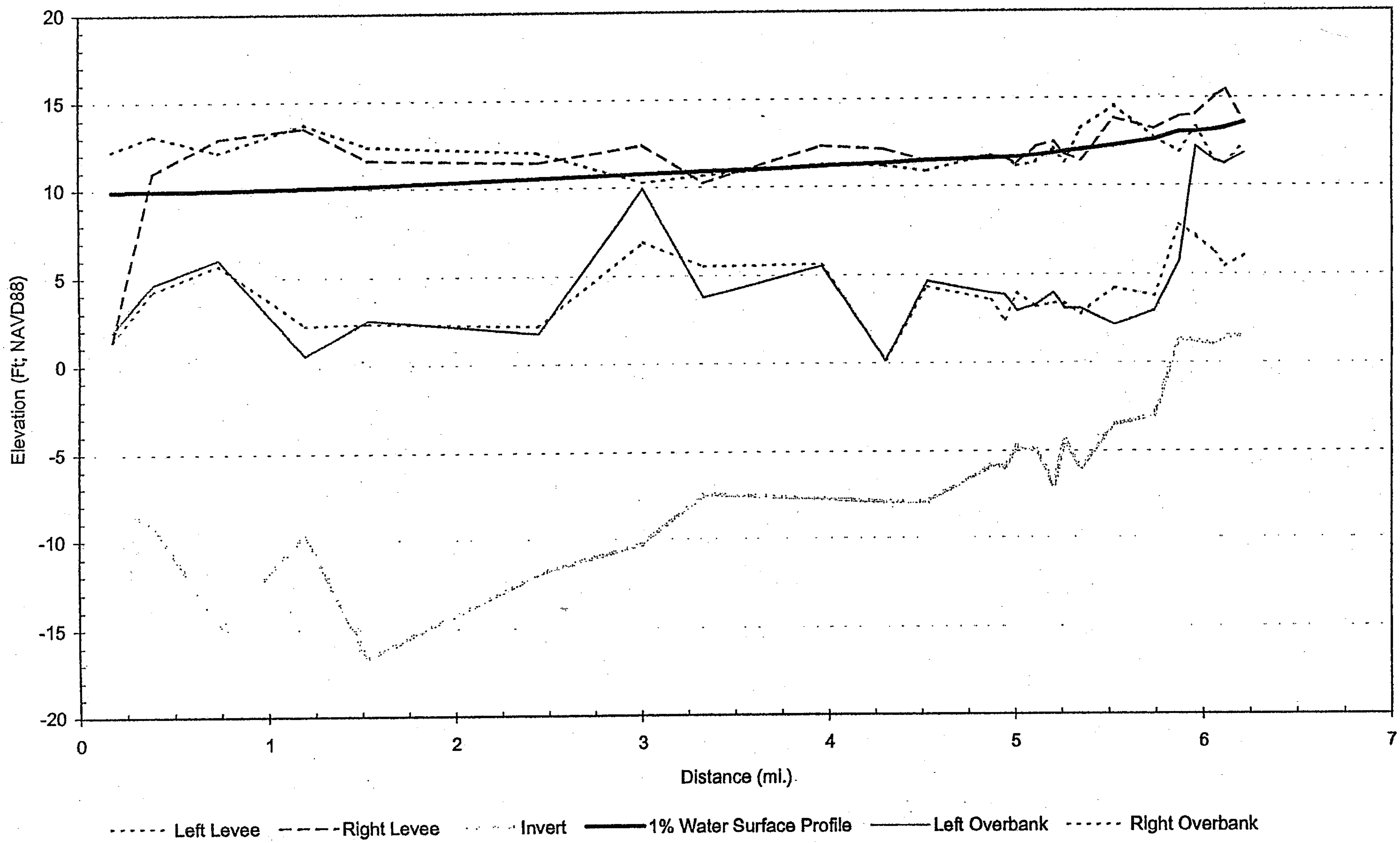
ALVISO SLOUGH PROFILES
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE
4

C:\Projects\50198 - LGR\Calcs\[leveeprofs.xls]Alviso Slough



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GUADALUPE SLOUGH PROFILES
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE
5

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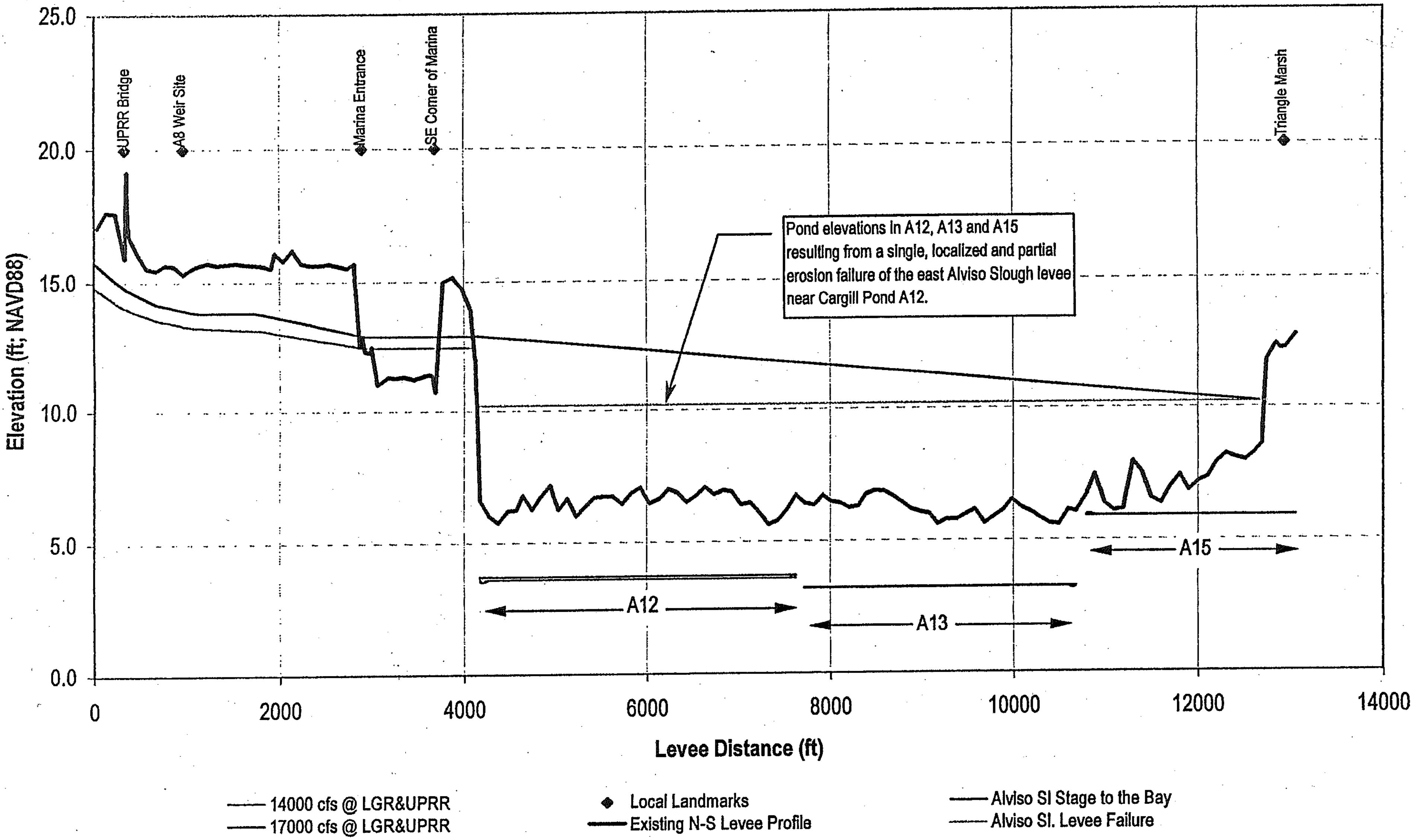

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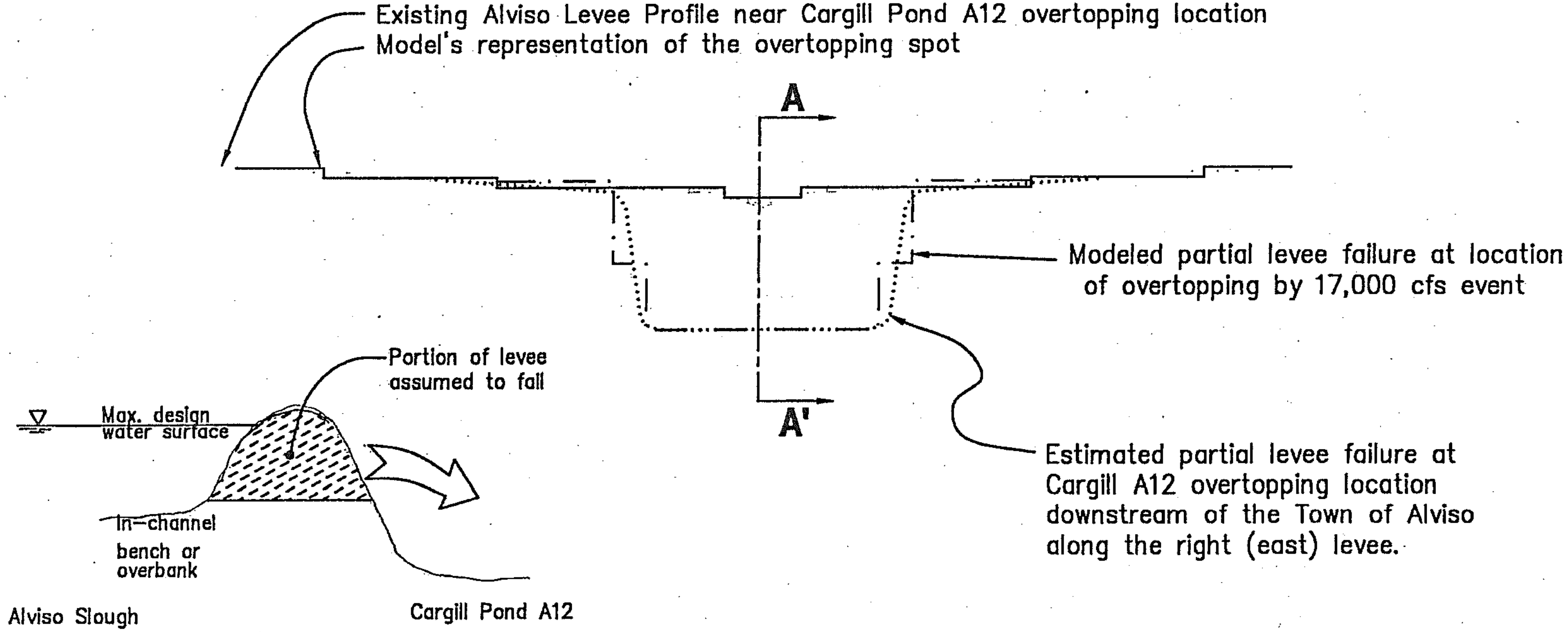
ALVISO NORTH-SOUTH LEVEE PROFILE
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE
6

LOCALIZED, PARTIAL BREACH OF ALVISO SLOUGH RIGHT LEVEE NEXT TO CARGILL POND A12 (Approx. RM 3.4668 mi)

ASSUMPTIONS:

- Guadalupe River QLPRR = 17,000 cfs
- Other mitigation plan components in–place
- No antecedent flood condions in study area
- No other levee failures occur throughout Alviso Sl.


Existing Alviso Levee Profile near Cargill Pond A12 overtopping location
Model's representation of the overtopping spot
A
A'
Modeled partial levee failure at location of overtopping by 17,000 cfs event
Estimated partial levee failure at Cargill A12 overtopping location downstream of the Town of Alviso along the right (east) levee.
Portion of levee assumed to fail
Max. design water surface
In–channel bench or overbank
Alviso Slough
Cargill Pond A12

Section A-A'

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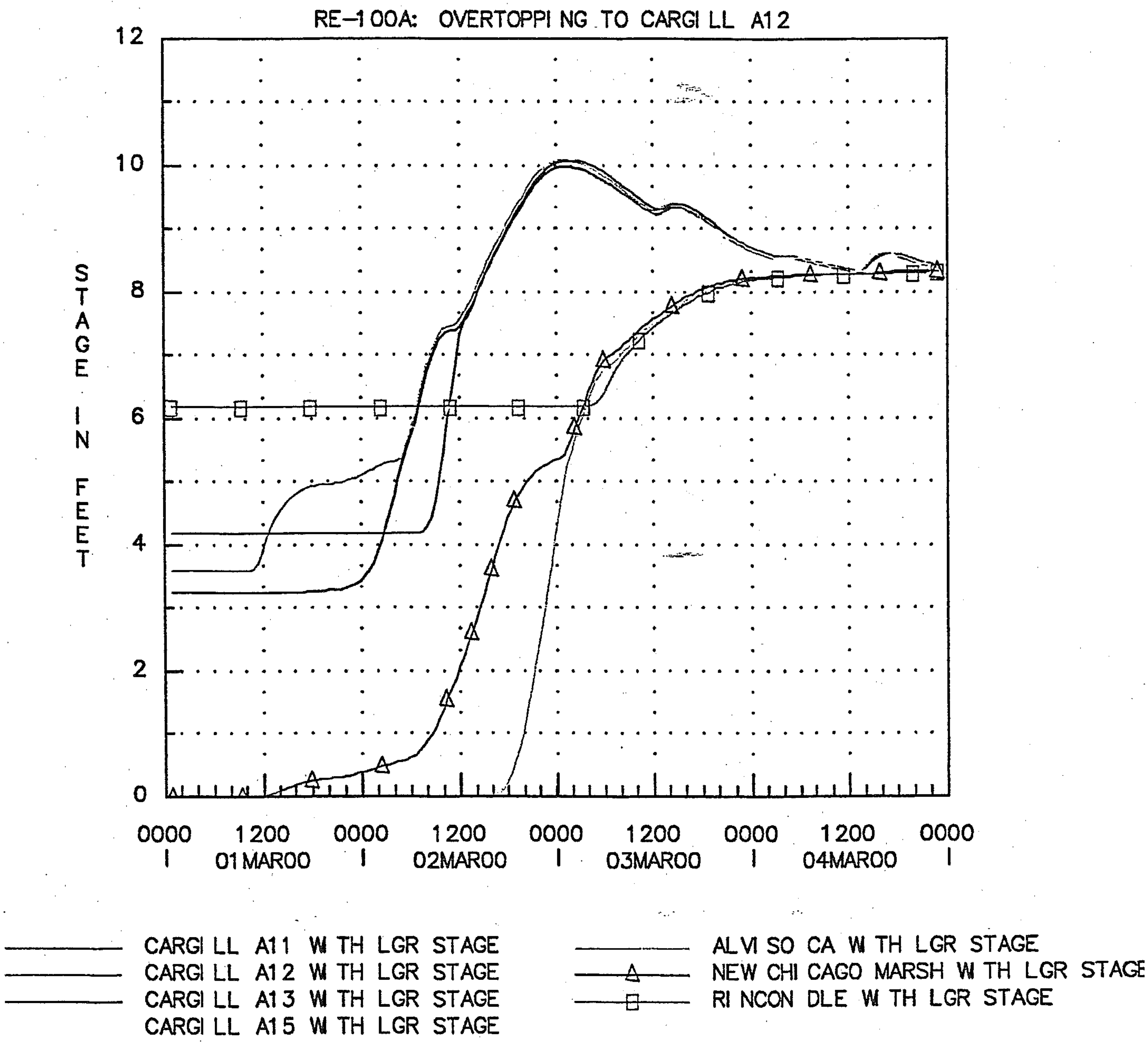
REPRESENTATIVE PARTIAL ALVISO SLOUGH LEVEE FAILURE
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE
7



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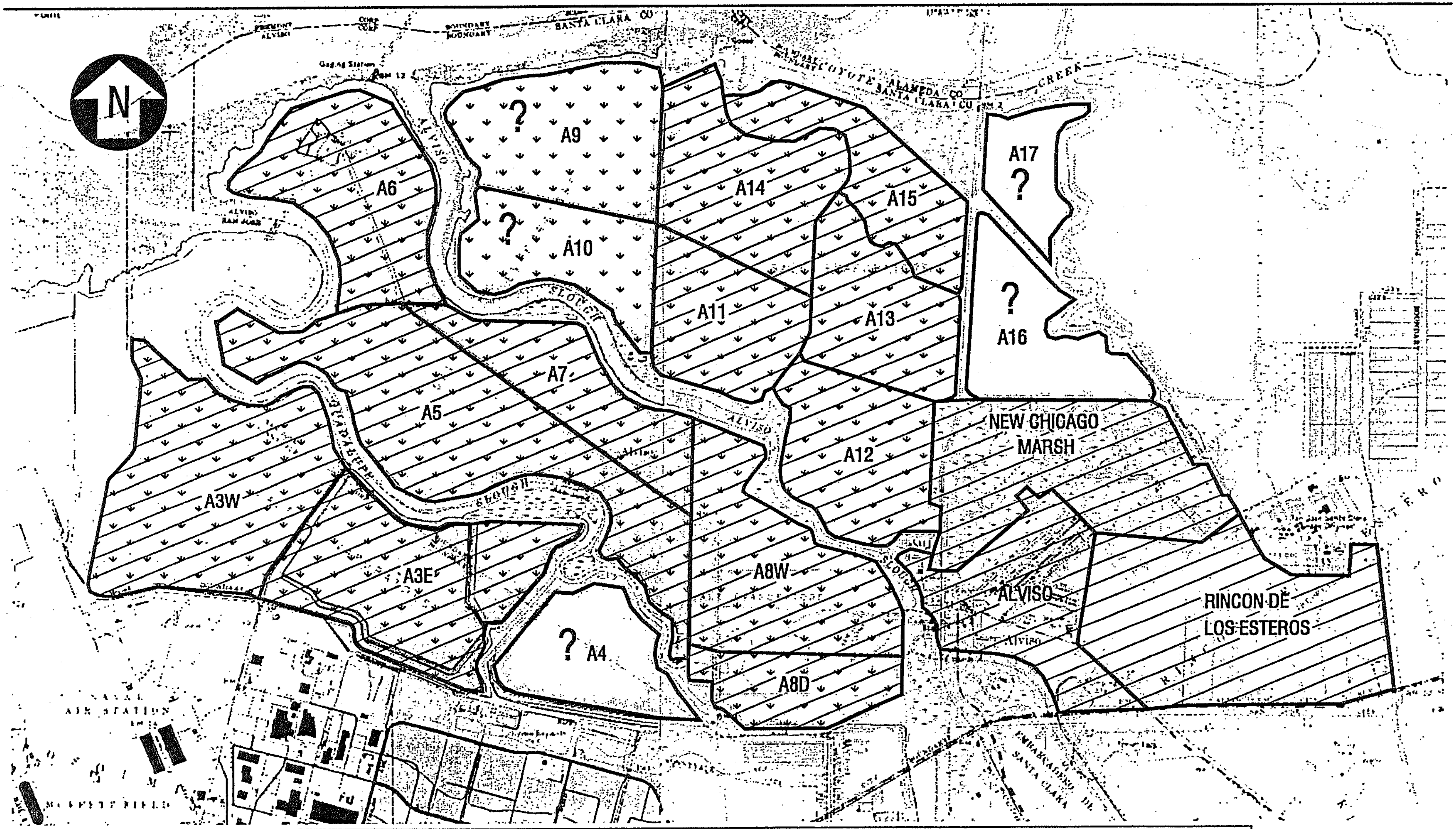
RESULTS OF SINGLE, LOCALIZED ALVISO SL. LEVEE BREACH
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE
8



LEGEND

? POTENTIAL FLOOD THREAT UNKNOWN
— APPROXIMATE STORAGE CELL BOUNDARY
▨ LANDS CONVERTED TO SALT MARSH
▨ AREAS LIKELY TO SEE INCREASED DEPTHS OF FLOODING

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POTENTIAL CONVERSION TO SALT MARSH HABITAT
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY

FIGURE
9

11 December 2000 **A2248/A2248a –Task 10**

MEMORANDUM FOR RECORD

TO: David Von Rueden, CH2M Hill

FROM: Loren Murray, P.E., and Robert MacArthur, P.E.

SUBJECT: Supplemental Baylands Incremental Analysis Results, nhc 50198

This memorandum summarizes the results from recent additional incremental numerical analyses of flooding potential within the Baylands Reconnaissance Study Area and concentrates on issues related primarily with flood risks directly associated with the Guadalupe River and the potential effects of upstream flood improvement projects.

References:
The following previously submitted documents are referred to in this Memo:
1. Memorandum from NHC to CH2M Hill dated 23 Oct 2000, rev. 13 Nov 2000; Subject: "*Incremental Baylands Reconnaissance Results*";

2. Draft Reconnaissance Report, *"Engineering and Environmental Reconnaissance Studies of the River Reach from UPRR to the Bay, Lower Guadalupe River,"* June 2000.

Purpose:
Northwest Hydraulic Consultants (NHC) conducted a reconnaissance-level investigation of the Baylands Study Area (Figure M1) during the Spring of 2000. In June 2000, NHC submitted a draft report summarizing the results from that investigation (Ref. No. 2). Following receipt of review comments from the District and additional comments discussed during meetings with the District and CH2M Hill, NHC was requested to perform additional incremental hydraulic analyses of the Baylands study area. Results from these most recent hydraulic analyses are summarized in NHC's November 13th Memorandum to CH2M Hill (Ref. No. 1). Following review of that memorandum by the District, NHC was instructed to prepare this memorandum that focuses on the identification and conceptual mitigation of potential Guadalupe River-only sources of flooding induced by construction of flood control improvements upstream of the UPRR bridge.

Caution:
The results and conceptual alternatives presented in this memorandum are based upon a reconnaissance level investigation. The intent of this investigation was to determine if the proposed Downtown and Lower Guadalupe River flood protection projects are likely to adversely impact the community of Alviso and neighboring Baylands. In addition, the investigation included the development of a limited number of conceptual flood protection schemes to mitigate the induced impacts. The information presented herewith is conceptual and is only intended to initiate discussion. It is not adequate for design. If mitigation measures are deemed necessary, a thorough feasibility-level investigation will be required in order to identify the full range of alternatives, evaluate those alternatives, and select and design the preferred plan.

Results:
Table M1 presents reconnaissance-level average depths of flooding in Bayland areas from the Guadalupe River for: (a.) today's conditions; (b.) future conditions with Lower Guadalupe River (LGR) and Downtown Guadalupe River (DNTN) Projects built but excluding stormwater pumping into the LGR; (c.) future conditions with LGR and DNTN Projects built and including stormwater pumping into the LGR; and (d.) future conditions with LGR, DNTN, stormwater pumping, and conceptual flood impact mitigation components implemented in the Baylands. Hydraulic boundary conditions and average depths of flooding for these four conditions are presented in Table M1 in columns 1 through 4, respectively. Figure M2 shows the locations of inundation areas identified in Table M1.

The primary purpose of the Baylands reconnaissance study was to: (1) use available information to identify and assess likely sources of flooding to Alviso and the Baylands, (2) to evaluate whether construction of flood control projects upstream of the UPRR bridge would induce flooding problems in Alviso or the Baylands, and (3) prepare a limited number of conceptual flood mitigation schemes if induced Guadalupe River flood problems are identified. Results summarized in this memo are based on NHC's recent hydraulic analyses; no environmental assessment of these results have been made yet. The following points summarize our key findings.

1. Alviso, New Chicago Marsh, and private (Cargill) and Federal (USFWS) lands are at risk of flooding from the Guadalupe River as well as other flood sources. This memo focuses primarily on Guadalupe River sources.
2. Average depths of flooding in Alviso under present (today's) conditions are approximately 8.8 feet deep (Column 1, Table M1). Following construction of the LGR and DNTN projects (including stormwater pumping) the average depths of flooding in Alviso during the design event are reduced to approximately 5.3 feet deep (Column 3) because the risks of levee overtopping upstream of the UPRR bridge is eliminated. We estimate that approximately 4.7 feet of the remaining 5.3 feet flooding in Alviso comes from Coyote Creek flood waters (Column 4).
3. Following construction of the LGR and DNTN Projects (and including stormwater pumping), the primary source of flooding into Alviso from the Guadalupe River is moved from the N. First Street corridor (previously from LGR levee overtopping) to the area downstream of the UPRR bridge along the east levee where levee overtopping will occur in the vicinity of the Alviso Marina.
4. Construction of the LGR and DNTN Projects (including pumping) increases the flow passing into Alviso Slough from 14,000 cfs to 20,000 cfs during the design (100-year) event.
5. As the magnitude of high flows increase in Alviso Slough following construction of the Guadalupe River Projects upstream, the elevation and volume of floodwaters entering Alviso through the Marina parking lot will increase unless higher levees or floodwalls are constructed (See Tables 2-4, Ref. No. 1).

6. As the magnitude of high flows increase in Alviso Slough following construction of the Guadalupe River projects upstream, depths of flooding in the salt ponds (average depths above present pond water surfaces) increase by approximately three (3) feet in ponds A5, A7, A8 and by almost eight (8) feet in the USFWS Refuge (pond A6). Minor flooding is also expected in some of the ponds north of Alviso.
7. **Acquisition of flood easements** through the Cargill Ponds A5, A7 and A8 as well as USFWS Refuge area (A6) **is essential to any LGR mitigation plan.** This is necessary to manage the increased flood flows conveyed by the LGR and DNTN projects into the Baylands study area. Without the easements and the associated flood storage and flow conveyance provided by those easements, there are no apparent implementable solutions.
8. Preparation of flood inundation and hazard mapping and determination of the duration of flooding are beyond the scope of this reconnaissance investigation and have not been done.
9. Average depths of flooding reported in Table M1 assume that all starting water surface elevations in the Baylands salt ponds and the top-of -levee elevations are at today's (existing conditions) elevations. Future pond use changes, levee improvements, tidal salt marsh restoration projects, etc. will affect the flooding dynamics of this area. Any filling of the ponds by antecedent floods or salt marsh restoration projects will significantly reduce the present-day flood storage and conveyance through ponds A5 through A8. Future reduction of storage and/or conveyance will result in increased water surface profiles (elevations) along Alviso and Guadalupe Sloughs, and the downstream portion of the Lower Guadalupe River, upstream of the UPRR bridge. This may induce greater flooding onto adjoining properties (public, private and Federal) and could affect the performance of the LGR flood control project upstream of UPRR bridge. Detailed analyses of future land use, pond or levee changes is beyond the scope of this reconnaissance study and have not been done.
10. Conceptual flood mitigation components were developed to minimize Guadalupe River-induced flooding to Alviso, resulting from the construction of upstream flood improvements. The limited mitigation components developed to date are only conceptual and are not adequate for feasibility or design level planning and they do not addressed other sources of flooding in Alviso. Locations, dimensions, elevations and the actual number of flood mitigation features are to be determined and refined during future planning and design analyses. The present conceptual components are briefly discussed in the next paragraphs of this memo.
11. Analyses of how to mitigate all sources of flooding to Alviso and to other private, public and federal lands in the Baylands study area are beyond the scope of this reconnaissance investigation.

Conceptual Mitigation Plan Components:
Figure M3 shows the approximate location of the conceptual mitigation features. The mitigation components consist of: (a) Alviso Slough Overflow Weir: a multi-crested concrete weir modeled as 100 L.f. @ elevation 10.25 ft (NAVD88), 200 L.f. @ 11.00 ft, and 200 L.f. @ 13.00 ft.;

(b) approximately 4,800± L.f. of Alviso Slough east levee improvements located between UPRR bridge and continuing downstream and around the Alviso Marina having an elevation (including 3.0’ of freeboard, however, FEMA may require more) of approximately 19.2± feet (upstream) to 18.2± feet (downstream) to protect against the design flood stage; (c) a one-way outlet system at the northwest side of the USFWS Refuge (formerly pond A6) consisting of five (5) 8-foot diameter conduits with flapgates on the outboard ends to allow interior drainage during low tides; and (d) flood easements across Cargill Ponds A5, A7 and A8 (wet and dry cells) as well as the USFWS Refuge (A6), totaling approximately 1,900± acres. Future feasibility analyses may find that additional inlets and outlets and levee improvements along Alviso and Guadalupe Sloughs may be required; pumping of interior ponds A8 wet and dry may also be required. The locations, dimensions, and numbers of these components may change during future feasibility planning and design.

Key Assumptions:
Refer to Reference No. 1 for a more detailed list of study limitations and assumptions. Key assumptions include:

- Results presented in this memo and the two other referenced documents (Refs. 1 & 2) are not intended for design;
- Flood easements will be obtained for Cargill ponds A5-A8 and the USFWS Refuge (A6);
- Results depicted in this memorandum do not account for future subsidence;
- Results presented in this memorandum do not account for future sea-level rise;
- Modeling geometry and topography are based on existing available data only, without substantial validation or infill of missing data;
- Future marsh/bay accretion processes throughout Alviso Slough are not accounted for, and hence future conveyance capacity of Alviso Slough is not considered;
- Future infill or modifications to Cargill ponds A5-A8 and the Refuge are not accounted for. Future conversion to salt marsh would result in loss of flood storage and conveyance which are not addressed here;
- All Bayland levees are assumed stable with no significant levee settlement or loss of structural integrity now and in the future;
- Initial pond water elevations are not affected by antecedent effects from previous storms or multiple significant storms nested within a wet season. Analyses of the effects of nested storm events are recommended for future studies;
- Local stormwater management infrastructures (pumps and facilities) accommodate up to a 10-year event. Residual interior runoff in the LGR reaches along N. First Street from a 100-year design event have not been accounted for in the assessment of possible flood sources to Alviso;

- Average depths of flooding in Alviso under today's conditions result primarily from North First Street corridor and Coyote Creek flooding and are based on available FEMA published 100-year floodplains data. Floodplain routing or mapping, duration of flooding and impacts assessments are beyond the scope of this study and were not done.

Recommendations:
Feasibility-level planning and final designs are necessary in order to develop specific and dependable flood mitigation features in the Baylands region. The present results of the Baylands hydraulic assessment are reconnaissance-level only and are not adequate for design of flood mitigation features. The previously submitted scope of work for future feasibility studies for the Baylands should be updated to reflect results and findings of these recent incremental analyses. The CH2M Hill study team also recommends additional field surveys and studies to address the Coyote Creek flood potential to Alviso and nearby federal and private lands.

NORTHWEST HYDRAULIC CONSULTANTS, Inc.

–/SIGNED/–
Loren A. Murray, P.E.

–/SIGNED/–
Robert C. MacArthur, P.E.

Encl (4): Table M1, Figs. M1 – M3.

Cf:
☐ Brad Hall, NHC
☐ Alan Solbert, J&S
☐ Ron Duke, HTH
☐ Jeff Johnson, NHC
☐ Steve Centerwall, J&S

TABLE M1

Estimated Average Inundation Depths in Alviso and Surrounding Area for Existing Conditions and Three Future Project Scenarios*

BOUNDARY CONDITIONS DURING THE DESIGN EVENT

Scenario:	**Today's Conditions**	**LGR&DNTN w/o SW Pumping**	**LGR&DNTN w/ SW Pumping**	**LGR&DNTN&PMP w/ BAYLANDS IMPROVEMENTS**
Lower Guad Flowrate (cfs):	14,000	17,000	20,000	20,000
Dumbarton Tide:	10-Yr	10-Yr	10-Yr	10-Yr
Other Tributaries[A]:	100-Yr	100-Yr	100-Yr	100-Yr
N.First St. Overland Q (cfs):	6,000	3,000	0	0
New Alviso Marina Levee:	No	No	No	Yes
Cargill A8W Overflow:	Yes	Yes	Yes	Yes
Improved[B] inflow and outflow for A5-A8:	No	No	No	Yes
Cargill A5-A8 is a Marsh[C]:	No	No	No	No

NOTE: On operating salt ponds, inundation depths represent depths of flooding above existing salt pond operating water surfaces, not the invert of the pond.

ESTIMATED AVERAGE INUNDATION DEPTHS (ft)

Location (See Fig.M2):	**Today's Conditions**	**LGR&DNTN w/o SW Pumping**	**LGR&DNTN w/ SW Pumping**	**LGR&DNTN&PMP w/ BAYLANDS IMPROVEMENTS**
Alviso:	8.8[D]	6.5[E]	5.3	4.7
New Chicago Marsh:	5.3[D]	5.0[E]	5.3	4.7
Rincon De Los Esteros:	2.8[D]	0.3[E]	-	-
Cargill Pond A5:	4.5	5.7	7.8	7.2
FWS Pond A6:	-	5.6	7.7	7.0
Cargill Pond A7:	4.5	5.8	7.8	7.3
Cargill Pond A8(Wet):	7.4	8.3	10.2	9.7
Cargill Pond A8(Dry):	4.5	6.0	7.8	7.3
Cargill Pond A11:	-	-	-	-
Cargill Pond A12:	-	-	0.3	0.4
Cargill Pond A13:	-	-	-	-
Cargill Pond A15:	-	-	-	-
Cargill Pond A16:	-	-	-	-
Cargill Pond A17:	-	-	-	-
Cargill Pond A3(East):	0.1	0.1	0.1	0.1
Cargill Pond A3(West):	-	-	-	-

A. Coyote Creek hydrograph has been lagged 11 hours behind Guadalupe River per J.Wang, SCVWD, 4/2000.

B. Construct an engineered weir at Cargill Pond A8W and Alviso Slough, and install five 8-ft diameter tide gates at the bay front levee (northwest) of the FWS Refuge (Pond A6). (See Figures M2 & M3)

C. Assumes Ponds A5-A8 are filled to create salt marsh with a new ground elevation of mean high water (MHW).

D. Inundation is dominated by the overland flooding resulting from LGR levee overtopping as depicted in FEMA FIP maps.

E. Inundation is the greater of either Marina levee overflows, or N. First Street overland flooding.

* *These results are based on a recon-level investigation of (1) likely sources of flooding in the Baylands, (2) an evaluation of whether construction of flood control projects upstream of UPRR bridge will induce additional flooding in Alviso or the Baylands, and (3) preliminary evaluation of conceptual flood mitigation components. Further feasibility planning and design investigations are required.*

11-Dec-00

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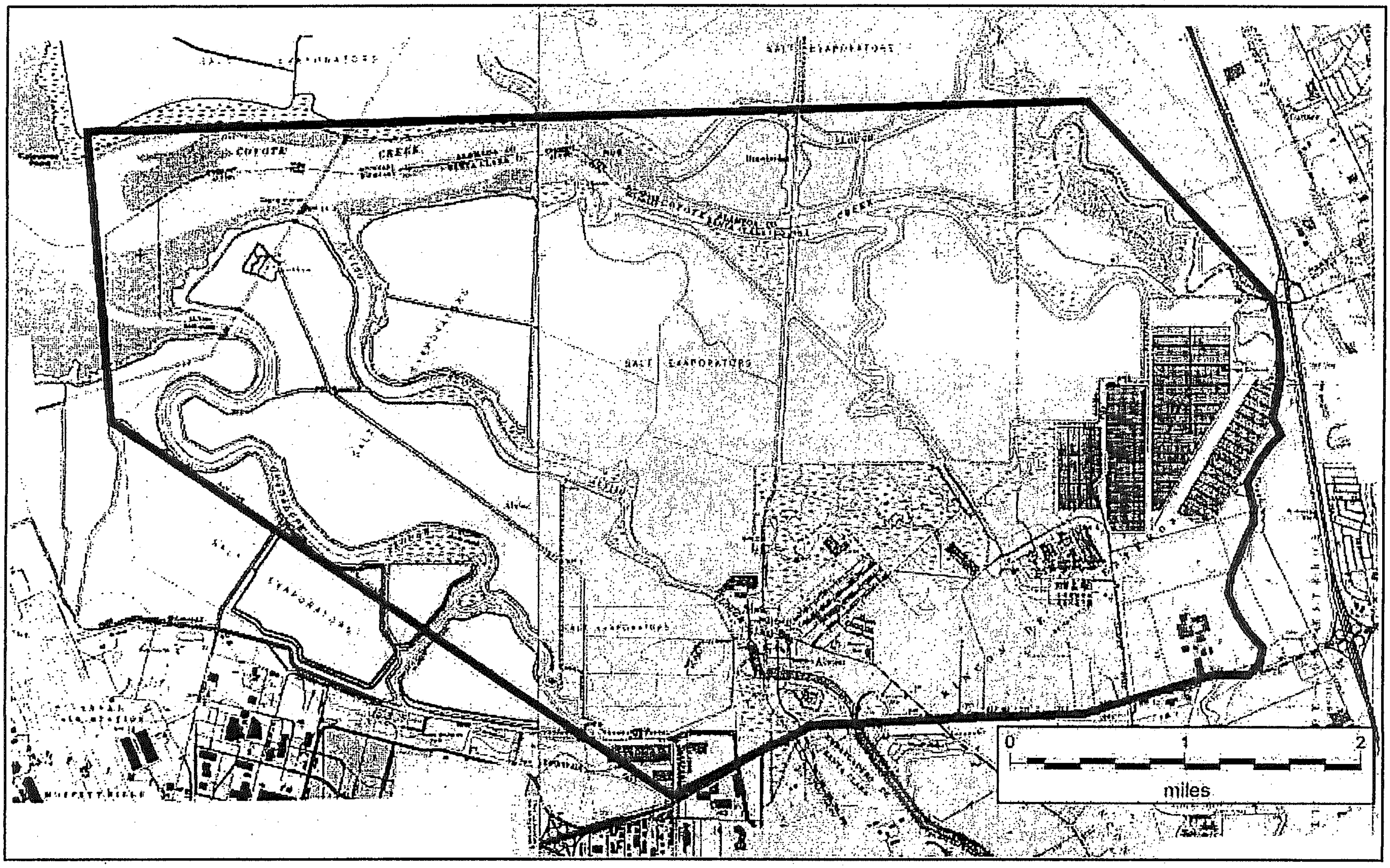

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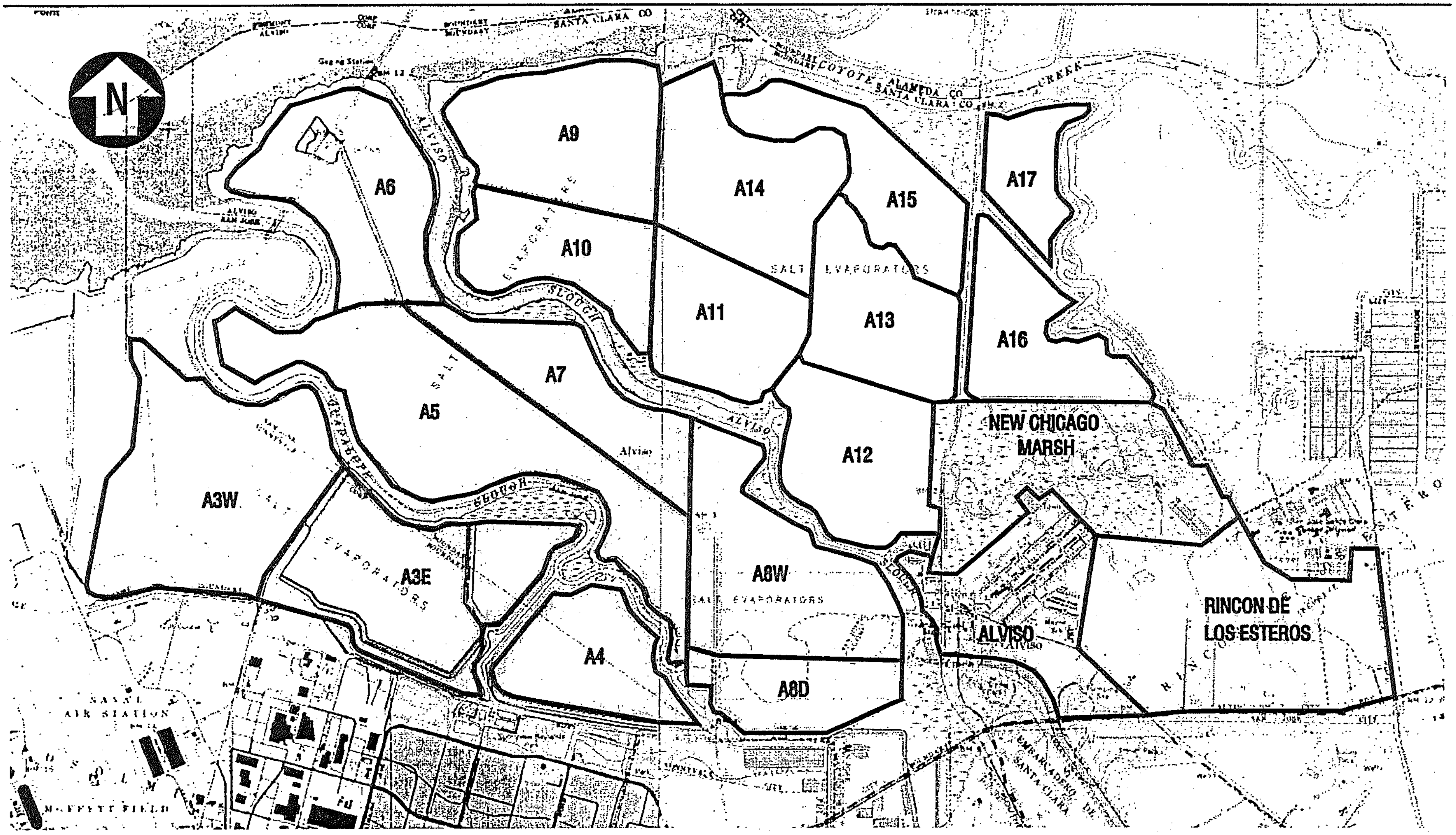
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
TASK 10 - RECONNAISSANCE STUDY
APPROXIMATE RECON STUDY BOUNDARY

FIGURE M1



LEGEND

A7 CARGILL EVAPORATOR POND NO.

——— APPROXIMATE STORAGE CELL BOUNDARY

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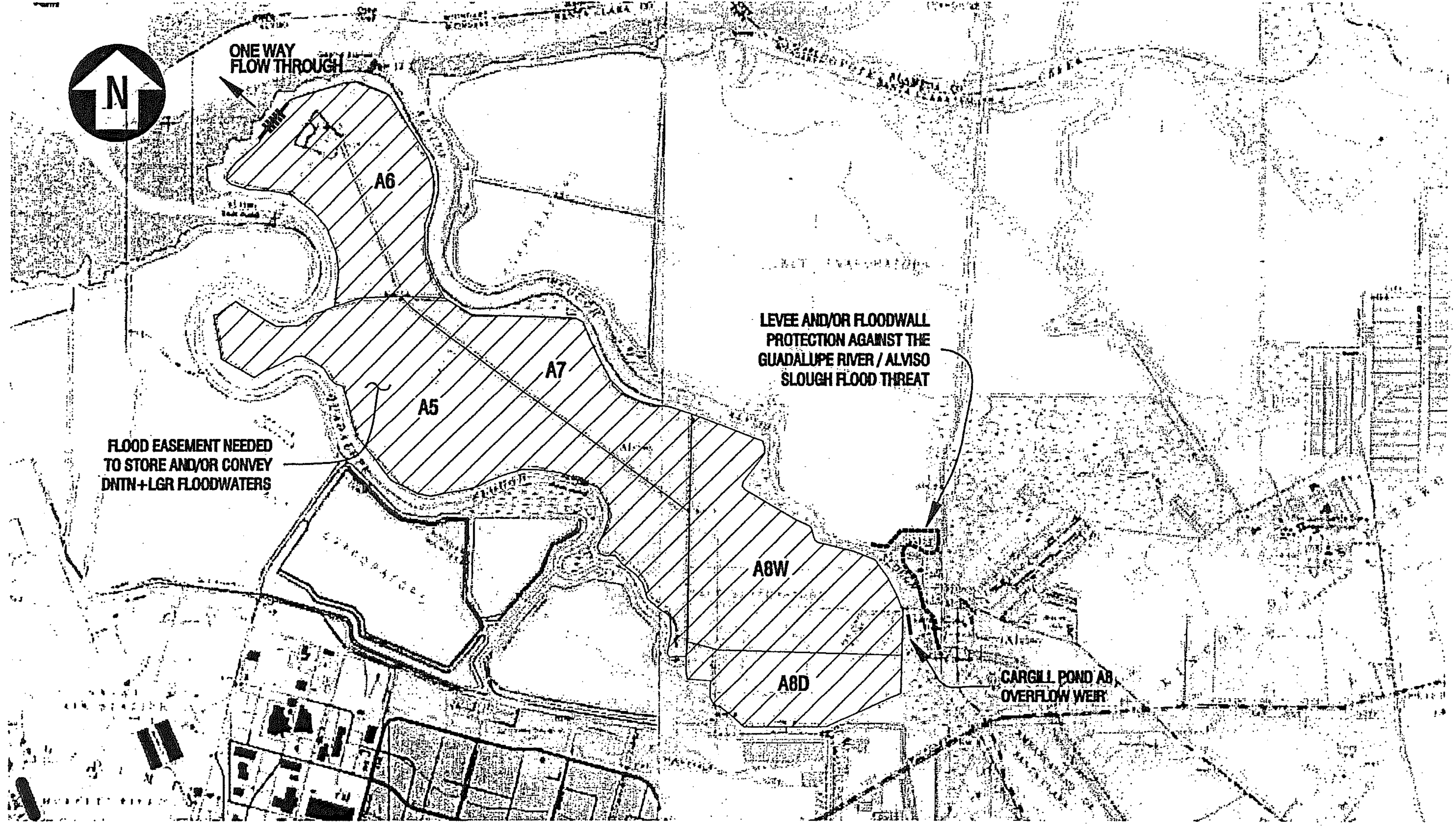
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY
DELINEATED UNET MODEL STORAGE CELLS

FIGURE
M 2


N
ONE WAY FLOW THROUGH
A6
A7
A5
A8W
A8D
LEVEE AND/OR FLOODWALL PROTECTION AGAINST THE GUADALUPE RIVER / ALVISO SLOUGH FLOOD THREAT
FLOOD EASEMENT NEEDED TO STORE AND/OR CONVEY DNTN+LGR FLOODWATERS
CARGILL POND A8 OVERFLOW WEIR

LEGEND

A7 CARGILL EVAPORATOR POND NO.

Note: 1. The size, number and locations of these baylands flood mitigation components are subject to change during feasibility planning and/or final design.
2. Additional outlets and pumping facilities may be required to evacuate some of the floodwaters stored in the overflow area.

11 December 2000

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LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY
CONCEPTUAL BAYLANDS IMPROVEMENTS

FIGURE M 3

COPY

MEMORANDUM

To: **Dave Von Rueden, CH2MHill**
From: Robert MacArthur, NHC
Date: Original 10-23-00, Updated 11-13-00
Subject: Incremental Baylands Reconnaissance Results

Dear Mr. Von Rueden:

The following Technical Memorandum summarizes the results from recent additional incremental numerical analyses of flooding potential within the Baylands Reconnaissance Study Area.

Purpose:
Figure 1 shows the approximate extent of the Baylands Reconnaissance study area. In June 2000, Northwest Hydraulic Consultants (NHC) submitted a draft report summarizing the results from our Baylands Reconnaissance Investigation. Following receipt of review comments from the District and additional comments discussed during recent meetings with Dennis Cheong and Saeid Hosseini, NHC has performed additional incremental hydraulic analyses of the Baylands study area, as requested. Results from these most recent hydraulic analyses are summarized in this Technical Memorandum. Please review these results and let us know if you have any comments or questions so we can finalize our summary and provide the results to the District.

Methods and Scenarios:
The modeling methodology used for these recent incremental analyses is essentially the same as discussed in the June 2000, Draft Reconnaissance Report and is based on readily available information. However, some model refinements were made at locations where additional topographic information was recently found.

Four sets of recent Baylands numerical modeling results are presented in the tables and discussions below for the following four primary scenarios. Incremental changes were made to each of these scenarios and re-analyzed to quantify the incremental effects of various proposed flood improvement projects and their flood-related effects on the Baylands study area (Figure 1). Results from the incremental analyses are summarized in Tables 1-5.

1. ***Present-Day Conditions*** - **No** Guadalupe River flood control improvements and **no** Baylands improvements.

2. ***Upstream Flood Improvements Only; No Pumping*** - **With** Guadalupe River Flood Control Improvements Upstream of UPRR (includes Downtown and LGR improvements), but **No Baylands Improvements** and **No stormwater pumping** into LGR.

3. *Upstream Flood Improvements Only; With Pumping* - **With** Guadalupe River Flood Control Improvements Upstream of UPRR (includes Downtown and LGR improvements), but **No Baylands Improvements** and **With stormwater** pumping into LGR.

4. *Baylands and Upstream Flood Improvements; With Pumping* - **With** Baylands improvements and Guadalupe River Flood Control Improvements Upstream of UPRR (includes minimum Baylands flood mitigation components, Downtown and LGR improvements), **With stormwater pumping** into LGR.

Executive Summary:
Under present day conditions the town of Alviso and adjacent Bayland areas shown in Figure 2 are highly susceptible to flooding from three primary sources: 1) from flows that can break out of the Guadalupe River downstream from Highway 237 when river discharges exceed the present-day channel capacity, 2) from high flow and stage conditions on Coyote Creek downstream of the recently constructed project, and 3) from possible overland flows from the North First Street corridor entering Alviso from the south. This third source of potential flooding results from excess local runoff and interior drainage coming from urban and industrial lands south and east of Alviso as well as possible Guadalupe River spills that can break out of the Lower Guadalupe River upstream of Highway 237.

Table 1 (attached) compares the computed flood depth estimates within Alviso and the Baylands area for three different flood protection scenarios: (1) present-day (today's) conditions, (2) future conditions with completed flood projects in Downtown San Jose and along the Lower Guadalupe River to UPRR **without** storm water pumping, and (3) with completed flood protection projects in Downtown San Jose and along the Lower Guadalupe River to UPRR **with** stormwater pumping into the Guadalupe River.

As shown in Table 1, the primary differences between the three scenarios are: (1) increases in Guadalupe River flows at UPRR bridge from 14,000 cfs, to 17,000 cfs, and up to 20,000 cfs.; (2) decreases in North First Street overland flows from 6,000 cfs down to 3,000 and 0 cfs; and (3) allowing or disallowing Coyote Creek flood waters to enter Alviso from the north of town. Common to each scenario were the following: (1) a 100-yr event within the Guadalupe River watershed; (2) 100-year events in neighboring watersheds that drain into Coyote Creek and the Guadalupe Slough; (3) a 10-year tide at Dumbarton bridge in the bay; and 4) the ability for excess Guadalupe River flows to spill out of Alviso Slough to the west into Cargill Pond A8W across from Alviso.

Columns 1 and 2 under the "Estimated Inundation Depths" portion of Table 1 show computed depths of flooding in Alviso and the surrounding Bayland areas for Present-Day Conditions **with** and **without** Coyote Creek flood effects occurring in Alviso. Depths of flooding in

TABLE 1
Incremental Analysis on Baylands Flooding Comparing No-Project Conditions to LGR and Downtown Project Improvements Upstream of UPRR

BOUNDARY CONDITIONS

Scenario:	Today's Conditions		LGR&DNTN w/o SW Pumping		LGR&DNTN w/ SW Pumping	
Lower Guad Flowrate:	14,000		17,000		20,000	
Dumbarton Tide:	10-Yr		10-Yr		10-Yr	
Other Tributaries [A]:	100-Yr		100-Yr		100-Yr	
N.First St. Overland Q:	6,000		3,000		0	
New Alviso Marina Levee:	No		No		No	
Cargill A8W Overflow:	Yes		Yes		Yes	
Improved [B] inflow and outflow for A5-A8:	No		No		No	
Cargill A5-A8 is a Marsh [C]:	No		No		No	
Coyote Creek Improvements:	Yes	No	Yes	No	Yes	No

ESTIMATED INUNDATION DEPTHS (ft)

NOTE: On operating salt ponds, inundation depths represent depths of flooding above existing salt pond operating water surfaces, not the invert of the pond.

Location (See Fig.2):	Today's Conditions		LGR&DNTN w/o SW Pumping		LGR&DNTN w/ SW Pumping	
Coyote Creek Improvements:	Yes	No	Yes	No	Yes	No
Alviso:	8.8[D]	8.8[D]	6.5[E]	6.5[E]	1.6	5.3
New Chicago Marsh:	5.3[D]	5.3[D]	7.0[E]	5.0[E]	7.0	5.3
Rincon De Los Esteros:	2.8[D]	2.8[D]	0.3[E]	0.3[E]	-	-
Cargill Pond A5:	4.5	4.5	5.7	5.7	7.8	7.8
FWS Pond A6:	-	-	5.6	5.6	7.7	7.7
Cargill Pond A7:	4.5	4.5	5.7	5.8	7.8	7.8
Cargill Pond A8(Wet):	7.4	7.4	8.3	8.3	10.2	10.2
Cargill Pond A8(Dry):	4.5	4.5	6.0	6.0	7.8	7.8
Cargill Pond A11:	-[F]	-[F]	-	-	-	-
Cargill Pond A12:	-[F]	-[F]	0.1	-	0.3	0.3
Cargill Pond A13:	0.4[F]	-[F]	0.5	-	0.5	-
Cargill Pond A15:	0.4[F]	-[F]	0.4	-	0.4	-
Cargill Pond A16:	-	-	-	-	-	-
Cargill Pond A17:	-	-	-	-	-	-
Cargill Pond A3(East):	0.1	0.1	0.1	0.1	0.1	0.1
Cargill Pond A3(West):	-	-	-	-	-	-

A. Coyote Creek hydrograph has been lagged 11 hours behind Guadalupe River per J.Wang, SCVWD, 4/2000.

B. Construct an engineered weir at Cargill Pond A8W and Alviso Slough, and install five 8-ft diameter tide gates at the bay front levee (northwest) of the FWS Refuge (Pond A6).

C. Assumes Ponds A5-A8 are accreted (filled) to salt marsh with a new ground elevation of mean high water (MHW).

D. Inundation is dominated by the overland flooding as depicted in FEMA FIP maps.

E. Inundation is the greater of either river overflows, or N. First Street overland flooding.

F. Pond inundation excludes N. First St. (FEMA) flooding; FEMA flooding increases flood depths to 3.1', 3.7', 4.1', and 1.4' to Cargill Ponds A11, A12, A13 and A15, respectively.

Alviso are on the order of 9 feet deep and range from approximately 0.5 feet to 7.5 feet in most of the salt ponds in the study area. All listed salt pond flooding depths represent the additional depths of water ABOVE existing (present day) pond water surfaces. Columns 3 and 4 show computed depths of flooding in Alviso and the salt ponds for completed project conditions upstream of UPRR **without** storm water pumping into Guadalupe River and for the conditions of **with** and **without** Coyote Creek flood effects occurring in Alviso. Columns 5 and 6 show computed depths of flooding in Alviso and the salt ponds for completed project conditions upstream of UPRR **with** interior pumping into Guadalupe River and for the conditions of **with** and **without** Coyote Creek flood effects occurring in Alviso. No Baylands project improvements (i.e. no flood protection improvements downstream from Highway 237) are included in the results shown in Table 1.

Table 1 shows that even if all Guadalupe River flood flows (including pumped flows) are contained by building flood control projects upstream of UPRR, significant risks of flooding to Alviso still exist from (1) Guadalupe River overtopping flows originating from Alviso Slough, and (2) from Coyote Creek high flows. We estimate that Alviso can still be flooded to a depth of approximately 5.5 feet during a 100-year event from Alviso Slough and from Coyote Creek (see Table 1, column 6) even if LGR and North First Street flood threats are eliminated. If flood risks from Coyote Creek are eliminated (Table 1, column 5), there can still be approximately 1.5 to 2.0 feet of Guadalupe River flooding in Alviso due to levee overtopping near the Alviso Marina even with extensive flood control projects in place upstream of UPRR. Details of the incremental numerical analyses summarized in Table 1 are listed in Tables 2-4.

Construction of flood control improvements upstream of UPRR reduces depths of flooding in Alviso, but increases the depths (and most likely the duration) of flooding in the private and federal salt ponds A5 through A13. Therefore, additional flood control improvements, including flood easements and structural features, are needed in the Baylands area downstream from Highway 237 in order to reduce or eliminate flood risks to Alviso and adjoining private and federal lands.

A conceptual layout of possible flood control improvements within the Baylands is presented in Figure 3. Table 5 summarizes results from an incremental analysis of possible components for a Baylands flood mitigation project downstream of UPRR. (These are conceptual components only. More accurate topography and design analyses are necessary to refine these concepts into dependable designs.) Column 3 (BL&USI-3) represents the Baylands flood mitigation concept intended to reduce only the Guadalupe River flood risks to Alviso. Such a project will require obtaining flood easements within ponds A5 through A8 and the design and construction of improved levees west and north of Alviso. Eliminating the Coyote Creek flood threat would include a long section of levee along the southern boarder of the New Chicago Marsh extending all the way to high ground near the City of San Jose Waste Water Treatment Plant east of town. The conceptual plan also calls for an engineered weir structure on the west bank of Alviso Slough downstream from the UPRR Bridge to spill excess flood waters into pond A8 and across to ponds A5, A6 and A7. Several outlet structures will be needed along the outboard levee of pond A6 to discharge these flood flows to the Bay. Low spots along the Alviso Slough and New

Chicago Marsh canal levees may also require improvements. However, presently available topographic information are insufficient to identify where and how extensive those types of improvements may have to be. Further data and analyses are required to determine what possible scenarios can be considered for flood-proofing the existing UPRR railroad tracks into Alviso. It is likely that temporary emergency flood barrier walls or flood-fighting improvements will be necessary to keep high flows from entering Alviso along the main line railroad tracks through town.

Further data, additional numerical analyses and feasibility level hydraulic design and environmental assessment activities are required to determine which Baylands flood improvement scenarios will best provide flood-risk reductions to Alviso and the adjoining private and federal lands. Phase 2 Baylands engineering planning activities have been described in previous draft scopes of work provided to the Water District by the Ch2MHill study team. Those scopes of work should be updated to reflect the recent results presented in this Memorandum.

Description of Scenarios Evaluated for the Incremental Analyses:
Detailed descriptions for each incremental modeling run within the four sets of general scenarios are summarized below. Results from each model run are presented in Tables 2 through 5 according to the same labeling protocol used below. Figure 2 delineates key locations where modeling results presented in all Tables 2 through 5.

1. Present-Day Conditions (see Table 2:) - No Guadalupe river flood control improvements and no Baylands improvements.

Present-Day Conditions: **(PD)**	Guadalupe River at max channel capacity, Q = 14K cfs 10-yr tide at Dumbarton Bridge 100-yr hydrographs on Tribs, Coyote Q_p lagged 11 hours No Downtown Flood Control Project Improvements No LGR Flood Control Project Improvements No Baylands Improvements Cargill Ponds still operated as salt ponds; no ponds filled

Description of Scenarios Considered for Incremental Analyses for Present-Day Conditions:

PD1 (Present Day - 1)	Guadalupe River at max channel capacity, Q = 14K cfs, etc. No effects of N. First Street flooding into Alviso *[If interior drainage pumping can not occur or keep up with storm runoff, excess flows can enter Alviso through the First Street corridor.]* No Coyote improvements; Coyote can still flood Alviso

	Overflow occurs into Cargill A8W ponds for Q_{GR}>6,800cfs
PD2 (Present Day - 2)	Guadalupe River at max channel capacity, Q = 14K cfs,etc. No effects of N. First Street flooding into Alviso No Coyote improvements; Coyote can still flood Alviso Overflow into Cargill A8W ponds ***can not occur***
PD3 (Present Day - 3)	Guadalupe River at max channel capacity, Q = 14K cfs,etc. No effects of N. First Street flooding into Alviso ***With*** Coyote improvements; ***NO Coyote flooding to Alviso*** Overflow occurs into Cargill A8W ponds for Q_{GR}>6,800cfs
PD4 (Present Day - 4)	Guadalupe River at max channel capacity, Q = 14K cfs,etc. No effects of N. First Street flooding into Alviso ***With*** Coyote improvements; ***NO Coyote flooding to Alviso*** Overflow into Cargill A8W ponds ***can not occur***
PD5 (Present Day -5)	Guadalupe River at max channel capacity, Q = 14K cfs,etc. ***Flooding from N. First into Alviso CAN occur*** from flows breaking out of the Guad river u/s of Hwy 237 ***With*** Coyote improvements; ***NO Coyote flooding to Alviso***; Overflow occurs into Cargill A8W ponds for Q_{GR}>6,800cfs
PD6 (Present Day –6)	Guadalupe River at max channel capacity, Q = 14K cfs,etc. ***Flooding from N. First into Alviso CAN occur*** from flows breaking out of the Guad river u/s of Hwy 237 ***With NO*** Coyote improvements; ***With Coyote flooding to Alviso***; Overflow occurs into Cargill A8W ponds for Q_{GR}>6,800cfs

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2. Upstream Flood Control Improvements Only, With No Pumping **(see Table 3) - With** Guadalupe River Flood Control Improvements Upstream of UPRR (includes Downtown and LGR improvements), but **No Baylands Improvements** and **No pumping** into LGR

US Fld Imprv'mnts Only With No Pumping: (USFINP)	Guadalupe River Q_P = 17K cfs, ***No pumping into LGR*** 10-yr tide at Dumbarton Brdg 100-yr hydrographs on Tribs, Coyote Q_p lagged 11 hours With Downtown Flood Control Project Improvements With LGR Flood Control Project Improvements No Baylands Improvements Cargill Ponds still operated as salt ponds; no ponds filled

Description of Scenarios Considered for Incremental Analyses for *Upstream Flood Control Improvements Only, No Baylands improvements and no pumping into LGR:*

USFINP-1 (US Fld Imp Only-1)	Guadalupe River Q_P = 17K cfs, etc., no pumping into LGR No effects of N. First Street flooding into Alviso *[If interior drainage pumping can not occur or keep up with storm runoff, excess flows can enter Alviso through the First Street corridor.]* With Coyote improvements; No Coyote flooding to Alviso Overflow occurs into Cargill A8W ponds for $Q_{GR}>6{,}800$cfs
USFINP-2 (US Fld Imp Only-2)	Guadalupe River Q_P = 17K cfs, etc., no pumping into LGR ***Flooding from N. First into Alviso CAN occur*** from ponded interior drainage not being pumped into LGR **With** Coyote improvements; **No** Coyote flooding to Alviso Overflow into Cargill A8W ponds *occurs*
USFINP-3 (US Fld Imp Only-3)	Guadalupe River Q_P = 17K cfs, etc., no pumping into LGR No effects of N. First Street flooding into Alviso **No** Coyote improvements; **Coyote can still flood Alviso** Overflow occurs into Cargill A8W ponds for $Q_{GR}>6{,}800$cfs
USFINP-4 (US Fld Imp Only-4)	Guadalupe River Q_P = 17K cfs, etc., no pumping into LGR ***Flooding from N. First into Alviso CAN occur*** from ponded interior drainage not being pumped into LGR **No** Coyote improvements; **Coyote can still flood Alviso** Overflow into Cargill A8W ponds ***occurs***
USFINP-5 (US Fld Imp Only-5)	Guadalupe River Q_P = 17K cfs, etc., no pumping into LGR **No effects** of N. First Street flooding into Alviso ***With*** Coyote improvements; ***NO Coyote flooding to Alviso*** Overflow into Cargill A8W ponds ***can not occur***
USFINP-6 (US Fld Imp Only-6)	Guadalupe River Q_P =17K cfs, no pumping into LGR **No effects** of N. First Street flooding into Alviso **No** Coyote improvements; **Coyote can still flood Alviso** Overflow into Cargill A8W ponds ***can not occur***

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3. Upstream Flood Control Improvements Only, With Pumping (Table 4) - With Guadalupe River Flood Control Improvements Upstream of UPRR (includes Downtown and LGR improvements), but **No Baylands Improvements** and **With pumping** into LGR.

US Fld Imprv'mnts Only, *With Pumping:* *(USFIWP)*	Guadalupe River Q_P = 20K cfs, ***With pumping into LGR*** 10-yr tide at Dumbarton Brdg 100-yr hydrographs on Tribs, Coyote Q_p lagged 11 hours With Downtown Flood Control Project Improvements With LGR Flood Control Project Improvements No Baylands Improvements Cargill Ponds still operated as salt ponds; no ponds filled

Description of Scenarios Considered for Incremental Analyses for *Upstream Flood Control Improvements Only, with pumping into LGR and No Baylands improvements:*

USFIWP-1 (US Fld Imp W P-1)	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into *Alviso [If interior drainage pumping can not occur or keep up with storm runoff, excess flows can enter Alviso through the First Street corridor.]* **No** Coyote improvements; **Coyote can still flood Alviso** Overflow into Cargill A8W ponds ***can occur***
USFIWP-2 (US Fld Imp W P-2)	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso **No** Coyote improvements; **Coyote can still flood Alviso** Overflow into Cargill A8W ponds ***can not occur***
USFIWP-3 (US Fld Imp W P-3)	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso ***With*** Coyote improvement; ***NO Coyote flooding to Alviso*** Overflow into Cargill A8W ponds ***can not occur***
USFIWP-4 (US Fld Imp W P-4)	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso ***With*** Coyote improvements; ***NO Coyote flooding to Alviso*** Overflow into Cargill A8W ponds ***can occur***
USFIWP-5 (US Fld Imp W P-5)	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso **No** Coyote improvements; **Coyote can still flood Alviso** Overflow into Cargill A8W ponds *can occur*, however, Ponds A-5 thru A-8 **have been converted to salt marsh** (no storage)
USFIWP-6 (US Fld Imp W P-6)	Guadalupe River Q_P = 20K cfs, with pumping into LGR

Peak flows on other tributaries reduced to 10-yr event
No effects of N. First Street flooding into Alviso
No Coyote improvements; **Coyote can still flood Alviso**
Overflow into Cargill A8W ponds ***can occur*** and ponds
A-5 thru A-8 are still operated as salt ponds

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*4. **Baylands and Upstream Flood Control Improvements and Pumping (see Table 5)*** - **With Conceptual** Baylands improvements and Guadalupe River Flood Control Improvements Upstream of UPRR (includes minimum Baylands flood mitigation components, Downtown and LGR improvements), **With pumping** into LGR.

BL&US Fld Imprv'mnts,
With Pumping:
(BL&USI)

Guadalupe River Q_P = 20K cfs, ***With pumping into LGR***
10-yr tide at Dumbarton Brdg
100-yr hydrographs on Tribs, Coyote Q_p lagged 11 hours
With Downtown Flood Control Project Improvements
With LGR Flood Control Project Improvements
With Baylands Improvements
Cargill Ponds still operated as salt ponds; no ponds filled

Description of Scenarios Considered for Incremental Analyses for *Baylands and Upstream Flood Control Improvements, with pumping into LGR:*

BL&USI-1

Guadalupe River Q_P = 20K cfs, with pumping into LGR
No effects of N. First Street flooding into Alviso *[If interior drainage pumping can not occur or keep up with storm runoff, excess flows can enter Alviso through the First Street corridor.]*
No Coyote improvements; **Coyote can still flood Alviso**
Overflow into Cargill A8W ponds ***can occur***, no imprv'nts
Alviso Marina area levee improvements are built

BL&USI-2

Guadalupe River Q_P = 20K cfs, with pumping into LGR
No effects of N. First Street flooding into Alviso
With Coyote improvements; ***NO Coyote flooding to Alviso***
Overflow into Cargill A8W ponds ***can occur***, no imprv'nts
Alviso Marina area levee improvements are built

BL&USI-3

Guadalupe River Q_P = 20K cfs, with pumping into LGR
No effects of N. First Street flooding into Alviso
With Coyote improvements; ***NO Coyote flooding to Alviso***

	Overflow into Cargill A8W ponds ***can occur*** **Alviso Marina area levee improvements are built, and Improvements are made to the inlet and outlets weirs in the Cargill Ponds A8W, etc.**
BL&USI-4	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso **No** Coyote improvements; **Coyote can still flood Alviso** Overflow into Cargill A8W ponds ***can occur***, no imprv'nts **Alviso Marina area levee improvements are built** **Cargill Ponds A-5 thru A-8 are converted to a marsh plain at MHW.**
BL&USI-5	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso **With** Coyote improvements; ***NO Coyote flooding to Alviso*** Overflow into Cargill A8W ponds ***can occur***, no imprv'nts **Alviso Marina area levee improvements are built;** **Cargill Ponds A-5 thru A-8 are converted to a marsh plain at MHW.**
BL&USI-6	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso **With** Coyote improvements; ***NO Coyote flooding to Alviso*** Overflow into Cargill A8W ponds ***can occur***, no imprv'nts **NO Alviso Marina area levee improvements; Cargill Ponds A-5 thru A-8 are converted to a marsh plain at MHW.**

Discussion of Results

1. Present-Day Conditions results are summarized in **Table 2.** Column PD1 shows potential depths of flooding at various key locations (see Figure 2) assuming Guadalupe River flows are at river conveyance capacity of approximately 14,000 cfs with no upstream flood control improvements in the downtown area or in the LGR reach and no Baylands improvements. Depths of flooding in Alviso are approximately 5 feet deep. Column PD2 demonstrates how important the present spills into the Cargill ponds west of Alviso are. Comparing PD1 with PD3 shows how vulnerable Alviso is to flooding from Coyote Creek and areas north and east of town. Note that eliminating the Coyote flood threat does not eliminate flooding in Alviso from Guadalupe River. PD4 shows that if flood improvements are made on the Coyote side of Alviso and the opportunity to spill excess Guadalupe River flows into the Cargill ponds west of town is eliminated, flooding in Alviso will still be approximately 3 feet deep from Guadalupe River flows. PD1 through PD4 all assume that there are no contributions to flooding in Alviso (almost

9 feet) from interior drainage entering town down North First Street. PD 5 and PD6 show the potential effects of "backdoor flooding" into Alviso from North First Street if flows on the Guadalupe were 20,000 cfs upstream of Hwy 237 and spilled out of the channel just upstream of Hwy 237. This vulnerability from First Street flooding could become even more dramatic for flows that exceed the ultimate channel design capacity of the proposed LGR flood control project. Construction of a ring levee south of Alviso to protect it from potential First Street flooding may only provide partial protection to the town and is more likely to create additional flooding to those properties just south of such a ring levee, and require pumping to handle those interior drainage problems.

2. Results for those conditions that include ***Upstream Flood Improvements Only and No Pumping*** are summarized in **Table 3.** Column USFINP-3 represents what could possibly occur today if upstream improvements (the downtown and LGR projects, with no pumping) are made with no improvements to prevent Coyote flooding and no Baylands improvements made to the Guadalupe River or Cargill ponds. Depths of flooding in Alviso with no upstream pumping (USFINP-3) are approximately 5 feet deep. USFINP-1 shows the effects of eliminating additional flooding from Coyote Creek. Flooding in Alviso is still on the order of 1 foot deep. USFINP-1 shows that Coyote creek improvements are likely to induce flooding to the ponds north of Alviso, thus requiring possible flood easements there as well. USFINP-2 shows the effects that potential First Street flooding contributions could make (an additional 5 to 6 feet deeper in town), even with no Coyote Creek flood contributions. USFINP-4 shows the effects that potential First Street flooding contributions could make in combination with the added effects of Coyote Creek flood contributions. USFINP-5 shows how critically important it is to spill excess flows into the Cargill ponds west of town (ponds A5 -A8). Note also that if spills can not occur into the west ponds A5- A8, spills are forced to occur into the ponds north of Alviso, with the possibility of entering town once they have filled. USFINP-6 shows the cumulative effects of no improvements to prevent Coyote flooding and no ability to spill into ponds A5 - A8. Flood depths in Alviso and the New Chicago Marsh area are approximately 7 feet deep.

3. Results for those conditions that include ***Upstream Flood Improvements Only With Pumping Into LGR*** are summarized in **Table 4.** USFIWP-1 represents what could possibly occur today if upstream improvements (the downtown and LGR projects, with pumping) are made with no improvements to prevent Coyote flooding and no Baylands improvements made to the Guadalupe River or Cargill ponds. Depths of flooding in Alviso and the New Chicago Marsh area (USFINP-1) are approximately 5.5 feet deep. Depths of flooding in Ponds A5 through A8 go up another two feet from those depths computed for the same scenario in Table 3 (see USFINP-3), without pumping. Depths of flooding in Alviso deepen to 7 feet deep (see USFIWP-2) if spilling can not occur into ponds A5-A8. USFIWP-2 also shows that if spill into ponds A5-A8 can't occur, then excess water spills into the ponds north of town (ponds A11-A15). The effects of Coyote Creek improvements are shown in column USFIWP-4. Depths of flooding in Alviso are on the order of 1.5 to 2 feet deep, but depths of flooding in Cargill ponds A12-A15 increase significantly. USFIWP-3 shows the effects of making Coyote Creek improvements but not being able to spill into ponds A5-A8; e.g., depths of flooding in Alviso are on the order of 7.5 to 8 feet.

All previous runs and scenarios assumed present conditions for all Cargill ponds. For the run USFIWP-5, we have assumed that someone has converted all of the Cargill ponds A5-A8 into tidal salt marsh with a bottom elevation at MHW. Spills into these areas can occur, but the effects of eliminating the initial flood storage provided under present conditions is shown to be about 2 to 1 foot of additional flooding in the Alviso and New Chicago Marsh areas. This also causes additional flooding into ponds A12 and A13 and increases the breakout flows to the west into ponds A3. USFIWP-6 shows the effects of assuming a lesser set of tributary boundary conditions with only a 10-year flood occurring on Coyote Creek and Guadalupe Slough tributaries. Depths of flooding into Alviso and the New Chicago Marsh areas are still approximately 3 to 4 feet deep with depths of flooding into ponds A5-A8 on the order of 7.5 to 10 feet deep. Some spill still occurs into pond A12.

4. Results for those conditions that include ***Baylands and Upstream Flood Improvements With Pumping Into LGR*** are summarized in **Table 5**. Column BL&USI-1 summarizes the conditions that might occur during the design event (20,000 cfs) if a flood control levee were built along the right bank of the Guadalupe River and through the County Marina to prevent Guadalupe River flows from overtopping from the west of town. Up to 5 feet of flooding may still occur in Alviso, even with such a levee if no improvements are made to prevent flooding from Coyote Creek assuming that no interior drainage flows enter town from North First Street, flooding in Alviso is eliminated by building the Marina levee and flood improvements to prevent flooding from Coyote (see BL&USI-2). Note that for BL&USI-2 there is still a requirement to obtain flood easements for those ponds north of town because flooding is induced in ponds A12, A13 and A15. BL&USI-3 represents the combined effects of building the Marina levee, eliminating Coyote flooding effects and improving the inlet and outlet efficiency for spills entering ponds A5-A8. If Coyote improvements are not made and only the Marina levee is constructed and ponds A5-A8 become tidal salt marsh areas with no other engineered improvements, then BL&USI-4 shows that flooding in Alviso and the New Chicago Marsh areas are on the order of 5 to 7 feet deep. Depths of flooding over the new marsh plain in ponds A5-A8 range from 4.5 to 7 feet deep. Column BL&USI-5 shows the effects of the Marina levee with Coyote improvements and ponds A5-A8 becoming tidal salt marsh areas with no other engineered improvements. New Chicago Marsh floods to a depth of about 7 feet, but no significant flooding occurs in Alviso. Ponds A12, A13 and A15 will require additional flood easements for scenario BL&USI-5. If Coyote improvements are made, but no Marina levee is built and ponds A5-A8 become tidal salt marsh areas with no other engineered improvements, then approximately 2.6 to 7 feet of flooding occurs in the Alviso and New Chicago Marsh areas. Ponds A12, A13 and A15 flood and will require additional flood easements for scenario BL&USI-6 as well. Scenarios BL&USI-4, BL&USI-5 and BL&USI-6 will all affect Cargill ponds A3 to the west.

Conclusions:
The following conclusions are based on results from the Baylands Reconnaissance Investigation:

- Alviso and the New Chicago Marsh areas are at risk of flooding from three primary sources: (1) Guadalupe River flows overtopping present-day levees upstream and/or west of Alviso, 2) Coyote Creek flooding from the north, and 3) interior drainage flow from the North First Street corridor.
- Table 1 shows that if all Guadalupe River flood flows (including pumped flows) are contained by building flood control projects upstream of UPRR, significant risks of flooding to Alviso still exist from (1) Guadalupe River overtopping flows originating from Alviso Slough, and (2) from Coyote Creek high flows.
- NHC estimates that with no flooding coming from the Guadalupe River upstream of UPRR that Alviso could still be flooded to a depth of approximately 5 feet during a 100-year event (see PD1).
- If interior drainage pumping along the N. First Street corridor cannot occur or keep up with storm runoff or flows that break out of the Guadalupe River, excess flows can enter directly into Alviso through the N. First Street corridor (Columns 1-4, Table 1).
- Increased Guadalupe River flows resulting from upstream flood control projects (in Downtown San Jose and LGR) will increase the risks and depths of flooding in Alviso and the New Chicago Marsh unless additional Baylands flood protection improvements are constructed (see PD3, USFINP-1, & USFIWP-4),
- Without Bayland improvements, flooding into other private and federal lands (pond areas west and north of Alviso) from the Guadalupe River worsens (depths and durations of flooding) as Guadalupe River flows increase due to flood control improvements associated with the downtown and LGR projects.
- Increasing Guadalupe River flows from 14,000 to 20,000 cfs at UPRR results in approximately a five-fold increase in flood depths in Alviso (with no flooding contributions from Coyote Creek, see PD3 & USFIWP-4) and approximately doubles the depths of flooding into the private and federal lands west and north of Alviso.
- Salt ponds A5, A7, and A8 are subject to flooding under present-day conditions (4.5 to 7 feet above present pond elevations for Q_{Guad}=14K cfs). Depths of flooding increase in A5 through A8 as Guadalupe River flows increase (8 to 10 feet above present pond elevations for Q_{Guad}=20K cfs)
- If no flooding is allowed into ponds A5-A8 in the future (e.g., no spill is allowed into ponds A5-A8), then flooding in Alviso and the New Chicago Marsh area is significantly increased (7 to 8 feet in Alviso). It is therefore, essential to acquire all necessary flood easements through private and federal ponds and perform additional planning and design analyses to assess proposed Baylands flood mitigation scenarios.
- In the future, if no spills are allowed into ponds A5-A8 and the downtown and LGR projects and Coyote Creek improvements were all in place, the estimated water surface

elevation at the peak of the design event near the AlvisoYacht Club across from the low weir area is about 17+ feet (NAVD 88). Adding 5 feet of freeboard to this for a coastal levee design, would require a levee crest at about 22 feet (NAVD 88) to protect Alviso from Guadalupe River design flows. Refer to the attached Alviso Slough - Plate 1.

- If the Cargill ponds A5-A8 are converted to salt marsh (at the elevation of MHW) and spills are allowed to occur over the new marsh plain area, a levee to protect Alviso would have to be at least 19.5 feet (NAVD 88) because of the loss of storage formerly available in the salt ponds. See attached Alviso Slough- Plate 2.
- When ponds A5-A8 are converted to salt marsh, the design event results in a stage increase near the mouth of Guadalupe Slough resulting in induced flooding into pond A3 East. (See USFIWP-5; BL&SUI-4, 5, 6.) Presently available topography indicates that levee surrounding Pond A4 may be high enough to prevent flooding, however, we recommend that actual levee elevations be verified during Phase 2 analyses.
- The USF&WS refuge in pond A6 is vulnerable to inundation for flood flows greater than 14,000 cfs on the Guadalupe River. Special flood easements from the USF&WS may be required for all of their lands. The potential for inundating other USF&WS ponds north of Alviso (ponds A12, 13, 15) for various flooding scenarios is also demonstrated herein. Duration of flooding impacts in these areas can not be determined from available information but are likely to be longer for the increased discharges and flood water volumes resulting from upstream flood control projects.
- Snowy Plover habitat in salt pond A8(dry) is vulnerable to inundation under present-day conditions as well as future with-project conditions. The range of flooding varies from 1.5 feet deep to 8 feet deep. The duration of flooding can not be determined from available information, but means for quickly draining or pumping those areas dry may be required as future mitigation for these areas. Analyses of specific impacts to this area will required additional topographic information and model refinements.
- Constructing Coyote Creek improvements to protect Alviso increases flooding into salt ponds A12, 13 and 15 and also increases the depths of flooding in the New Chicago Marsh area, thus possibly requiring additional flood easements or mitigation agreements with the USF&WS.
- Further data, additional Phase 2 numerical analyses and feasibility level hydraulic design and environmental assessment activities are required to determine which Baylands flood improvement scenarios will best provide flood-risk reductions to Alviso and the adjoining private and federal lands while minimizing possible impacts to the environment.

Study Limitations and Assumptions

Following are key assumptions and limitations associated with the reconnaissance study results. Results from this reconnaissance investigation are not sufficient for design purposes. Additional data and analyses are necessary to refine these preliminary results into planning level information necessary to better determine project performance, costs and potential environmental impacts.

- All results are based on available information
- Reliable topography is lacking for the Baylands study area
- All runs and scenarios assumed present-day conditions for all Cargill ponds unless otherwise stated
- Flooding impacts to Alviso from the First Street corridor are estimated from published FEMA information and very simplified volume routing procedures
- Results for all of the Bayland improvements scenarios are based solely on conceptual improvements. Further detailed data and analyses are required to develop reliable flood mitigation features, cost estimates and environmental impacts
- We assumed no levee failures during all events evaluated. Failures will dramatically change these results. Most of the levees in the Bayland area are unengineered private levees with unknown geotechnical characteristics
- We did not consider levee settlement, channel accretion or subsidence
- We did estimate the effects of 1 foot of sea level rise at the Dumbarton Bridge. This results in approximately one foot of water surface rise near Alviso for all flooding scenarios. The effects of future sea level rise is NOT reflected in any of the tabular results presented in Tables 1-5
- All analyses herein assume no antecedent effects from previous storm events. Historical flow records show that it is likely, however, to have significant events occurring prior to a rare event. It is therefore necessary to provide adequate methods to drain ponds A5-A8 prior to the next event or resulting water surface profiles will be higher than estimated in Tables 1-5
- All of our analyses show how very sensitive computed water surface elevations are to small changes in land surface and levee elevations. More detailed topography is required prior to further analyses or design
- We can't forecast future levee conditions due to maintenance or the lack of maintenance on the private levees
- Future project performance will depend on whether present levees continue to be stable for all future conditions and flows
- For most of the scenarios presented we have assumed that all necessary flood easements have been obtained
- If interior drainage pumping along the First Street corridor can not occur or keep up with storm runoff or flows that break out of the Guadalupe River, excess flows can enter directly into Alviso through the First Street corridor. This source of potential flooding merits further investigation and analysis
- For all scenarios we assume that the resource agencies responsible for managing those areas subject to flooding will allow future, and perhaps deeper flooding to occur. Required mitigation for those effects are unknown.

Recommendations:
Northwest Hydraulic Consultants and CH2MHill recommends that a feasibility level design study be performed within the Baylands study area in order to develop specific and dependable flood mitigation features to protect Alviso and the adjoining private and federal lands from Guadalupe River flood flows. It is important to remember that the study results herein are approximate and are based upon a reconnaissance level investigation which is not adequate for design of flood protection features. The feasibility study has been described in previous draft scopes of work provided to the Water District by the CH2M study team. The scope of work should be updated to reflect the results and findings of this reconnaissance study. The CH2M study team also recommends additional studies to address the Coyote Creek flood potential to Alviso and nearby private/federal lands.

FIGURES, TABLES AND PLATES

referenced in this Technical Memo

See following pages

TABLE 2
PRESENT-DAY CONDITIONS
(No LGR or DNTN Projects built; No Baylands Improvements)

BAYLANDS BOUNDARY CONDITIONS

Scenario:	PD1	PD2	PD3	PD4	PD5	PD6
Lower Guad Flowrate:	14,000	14,000	14,000	14,000	14,000	14,000
Dumbarton Tide:	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr
Other Tributaries[A]*:*	100-Yr	100-Yr	100-Yr	100-Yr	100-Yr	100-Yr
N.First St. Overland Flows:	0	0	0	0	6,000	6,000
Coyote Creek Improvements:	No	No	Yes	Yes	Yes	No
Cargill A8W Overflow:	Yes	No	Yes	No	Yes	Yes
Cargill A5-A8 is a Marsh:	No	No	No	No	No	No

ESTIMATED INUNDATION DEPTHS (ft)

Location:	PD1	PD2	PD3	PD4	PD5	PD6
Alviso:	4.8[B]	5.8[B]	0.3[B]	2.9[B]	8.8[C]	8.8[C]
New Chicago Marsh:	4.8[B]	5.8[B]	4.8[B]	7.0[B]	5.3[C]	5.3[C]
Rincon De Los Esteros:	-[B]	-[B]	-[B]	-[B]	2.8[C]	2.8[C]
Cargill Pond A5:	4.5	2.6	4.5	4.1	4.5	4.5
FWS Pond A6:	-	-	-	-	-	-
Cargill Pond A7:	4.5	3.0	4.5	3.0	4.5	4.5
Cargill Pond A8(Wet):	6.9	1.7	7.4	1.7	7.4	7.4
Cargill Pond A8(Dry):	4.4	1.5	4.5	1.5	4.5	4.5
Cargill Pond A11:	-	-	-	-	-[D]	-[D]
Cargill Pond A12:	-	1.0	-	1.0	-[D]	-[D]
Cargill Pond A13:	-	-	0.4	0.5	0.4[D]	-[D]
Cargill Pond A15:	-	-	0.4	0.4	0.4[D]	-[D]
Cargill Pond A16:	-	-	-	-	-	-
Cargill Pond A17:	-	-	-	-	-	-
Cargill Pond A3(East):	0.1	0.1	0.1	0.1	0.1	0.1
Cargill Pond A3(West):	-	-	-	-	-	-

A. Coyote Creek hydrograph has been lagged 11 hours behind Guadalupe River per J.Wang, SCVWD, 4/2000.

B. Excludes the depth associated with inundation due to overland flooding from N. First Street.

C. Inundation is the greater of either river overflows, or N. First Street overland flooding.

D. Pond inundation excludes N. First St. (FEMA) flooding; FEMA flooding increases flood depths to 3.1', 3.7', 4.1', and 1.4' to Cargill Ponds A11, A12, A13, and A15, respectively.

TABLE 3
LOWER GUADALUPE RIVER AND DOWNTOWN PROJECTS ONLINE
(No San Jose Stormwater Pumping into LGR; No Baylands Improvements)

BAYLANDS BOUNDARY CONDITIONS

Scenario:	USFINP-1	USFINP-2	USFINP-3	USFINP-4	USFINP-5	USFINP-6
Lower Guad Flowrate:	17,000	17,000	17,000	17,000	17,000	17,000
Dumbarton Tide:	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr
Other Tributaries[A]*:*	100-Yr	100-Yr	100-Yr	100-Yr	100-Yr	100-Yr
N.First St. Overland Q:	0	3,000	0	3,000	0	0
Coyote Creek Improvements:	Yes	Yes	No	No	Yes	No
Cargill A8W Overflow:	Yes	Yes	Yes	Yes	No	No
Cargill A5-A8 is a Marsh:	No	No	No	No	No	No

ESTIMATED INUNDATION DEPTHS (ft)

Analysis Results:	USFINP-1	USFINP-2	USFINP-3	USFINP-4	USFINP-5	USFINP-6
Alviso:	0.7[B]	6.5[C]	4.9[B]	6.5[C]	6.3[B]	6.8[B]
New Chicago Marsh:	7.0[B]	7.0[C]	5.0[B]	5.0[C]	7.0[B]	6.8[B]
Rincon De Los Esteros:	-[B]	0.3[C]	-[B]	0.3[C]	0.1[B]	0.5[B]
Cargill Pond A5:	5.7	5.7	5.7	5.7	3.3	3.3
FWS Pond A6:	5.6	5.6	5.6	5.6	-	-
Cargill Pond A7:	5.7	5.7	5.8	5.8	3.2	3.3
Cargill Pond A8(Wet):	8.3	8.3	8.3	8.3	4.5	4.5
Cargill Pond A8(Dry):	6.0	6.0	6.0	6.0	2.1	2.2
Cargill Pond A11:	-	-	-	-	-	-
Cargill Pond A12:	0.1	0.1	-	-	2.0	1.8
Cargill Pond A13:	0.5	0.5	-	-	2.2	2.2
Cargill Pond A15:	0.4	0.4	-	-	0.4	0.1
Cargill Pond A16:	-	-	-	-	-	-
Cargill Pond A17:	-	-	-	-	-	-
Cargill Pond A3(East):	0.1	0.1	0.1	0.1	0.1	0.1
Cargill Pond A3(West):	-	-	-	-	-	-

A. Coyote Creek hydrograph has been lagged 11 hours behind Guadalupe River per J.Wang, SCVWD, 4/2000.

B. Excludes the depth associated with inundation due to overland flooding from N. First Street.

C. Inundation is the greater of either river overflows, or N. First Street overland flooding.

TABLE 4
LOWER GUADALUPE RIVER AND DOWNTOWN PROJECTS ONLINE
(Includes Stormwater Pumping into LGR; Excludes Baylands Improvements)

BAYLANDS BOUNDARY CONDITIONS

Scenario:	USFIWP-1	USFIWP-2	USFIWP-3	USFIWP-4	USFIWP-5	USFIWP-6
Lower Guad Flowrate:	20,000	20,000	20,000	20,000	20,000	20,000
Dumbarton Tide:	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr
Other Tributaries[A]:	100-Yr	100-Yr	100-Yr	100-Yr	100-Yr	10-Yr
N.First St. Overland Q:	0	0	0	0	0	0
Coyote Creek Improvements:	No	No	Yes	Yes	No	No
Cargill A8W Overflow:	Yes	No	No	Yes	Yes	Yes
Cargill A5-A8 is a Marsh:	No	No	No	No	Yes	No

ESTIMATED INUNDATION DEPTHS (ft)

Analysis Results:	USFIWP-1	USFIWP-2	USFIWP-3	USFIWP-4	USFIWP-5	USFIWP-6
Alviso:	5.3	7.0	7.6	1.6	5.8	3.0
New Chicago Marsh:	5.3	7.0	7.0	7.0	6.6	3.8
Rincon De Los Esteros:	-	0.7	1.3	-	-	-
Cargill Pond A5:	7.8	3.4	3.5	7.8	5.1[D]	7.4
FWS Pond A6:	7.7	-	-	7.7	4.4[D]	7.2
Cargill Pond A7:	7.8	3.4	3.4	7.8	5.1[D]	7.4
Cargill Pond A8(Wet):	10.2	5.7	5.7	10.2	6.7[D]	9.7
Cargill Pond A8(Dry):	7.8	3.4	3.3	7.8	6.2	7.4
Cargill Pond A11:	-	2.6	2.3	-	-	-
Cargill Pond A12:	0.3	3.4	3.2	0.3	1.5	0.2
Cargill Pond A13:	-	3.8	3.5	0.5	0.6	-
Cargill Pond A15:	-	1.2	0.5	0.4	-	-
Cargill Pond A16:	-	-	-	-	-	-
Cargill Pond A17:	-	-	-	-	-	-
Cargill Pond A3(East):	0.1	0.1	0.1	0.1	0.3	-
Cargill Pond A3(West):	-	-	-	-	-	-

A. Coyote Creek hydrograph has been lagged 11 hours behind Guadalupe River per J.Wang, SCVWD, 4/2000.

B. Excludes the depth associated with inundation due to overland flooding from N. First Street.

C. Inundation is the greater of either river overflows, or N. First Street overland flooding.

D. Accreted marsh surface effectively brought up the bottom (starting elev.) of the pond.

TABLE 5
LOWER GUADALUPE RIVER AND DOWNTOWN PROJECTS ONLINE
(Includes San Jose Pumping into LGR; Includes Baylands Improvements)

BAYLANDS BOUNDARY CONDITIONS

Scenario:	BL&USI-1	BL&USI-2	BL&USI-3	BL&USI-4	BL&USI-5	BL&USI-6
Lower Guad Flowrate:	20,000	20,000	20,000	20,000	20,000	20,000
Dumbarton Tide:	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr
Other Tributaries[A]*:*	100-Yr	100-Yr	100-Yr	100-Yr	100-Yr	100-Yr
N.First St. Overland Q:	0	0	0	0	0	0
New Alviso Marina Levee:	Yes	Yes	Yes	Yes	Yes	No
Coyote Creek Improvements:	No	Yes	Yes	No	Yes	Yes
Cargill A8W Overflow:	Yes	Yes	Yes	Yes	Yes	Yes
Improved[B] *inflow and outflow for A5-A8:*	No	No	Yes	No	No	No
Cargill A5-A8 is a Marsh[C]*:*	No	No	No	Yes	Yes	Yes

ESTIMATED INUNDATION DEPTHS (ft)

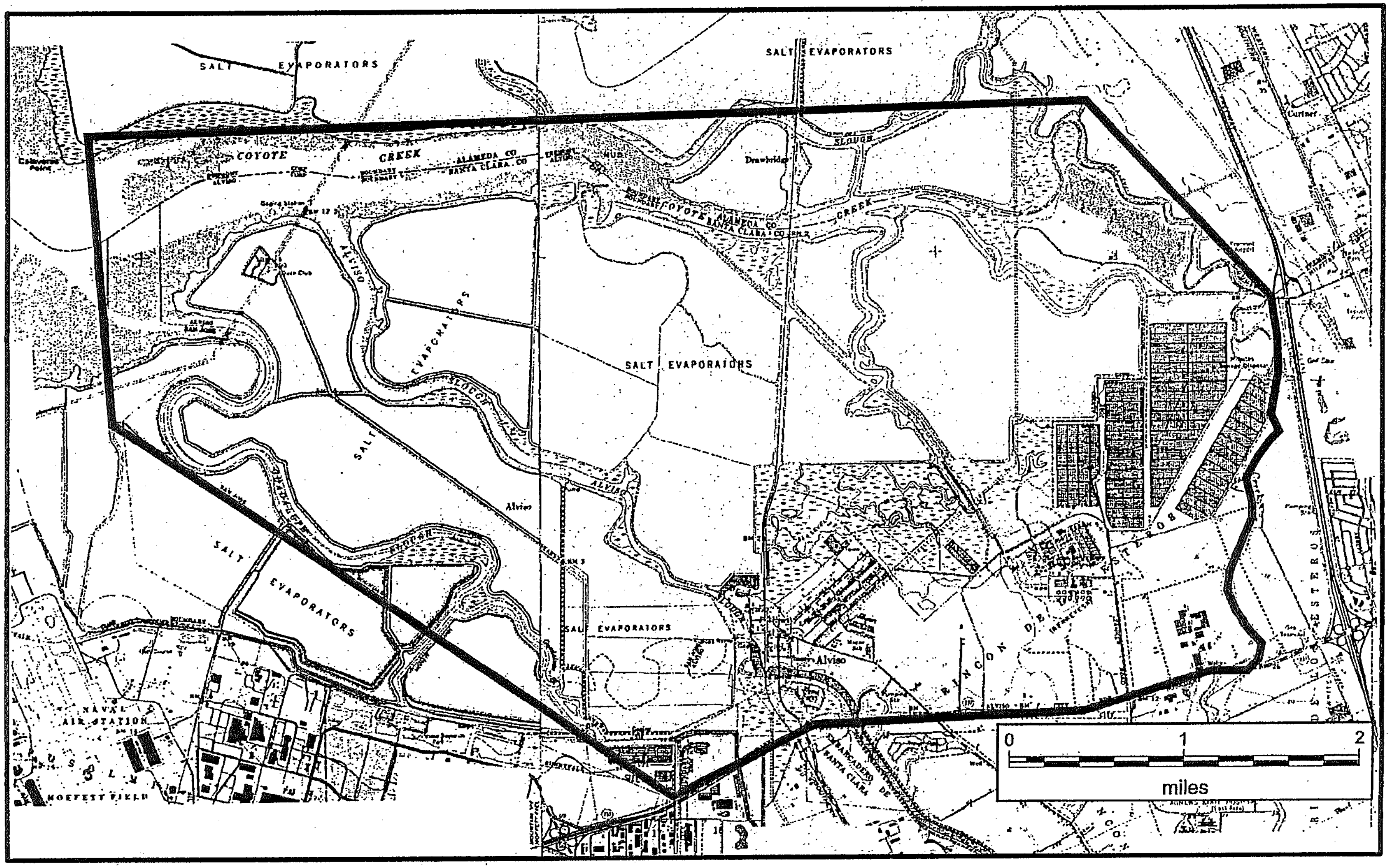
Analysis Results:	BL&USI-1	BL&USI-2	BL&USI-3	BL&USI-4	BL&USI-5	BL&USI-6
Alviso:	4.8	-	-	4.8	-	2.6
New Chicago Marsh:	4.8	7.0	7.0	6.6	7.1	7.0
Rincon De Los Esteros:	-	-	-	-	-	-
Cargill Pond A5:	8.0	8.0	7.3	5.1[D]	5.1[D]	5.1[D]
FWS Pond A6:	7.8	7.8	7.0	4.4[D]	4.4[D]	4.4[D]
Cargill Pond A7:	8.0	8.0	7.3	5.1[D]	5.1[D]	5.1[D]
Cargill Pond A8(Wet):	10.3	10.3	9.7	6.7[D]	6.7[D]	6.7[D]
Cargill Pond A8(Dry):	8.0	8.0	7.4	6.2	6.2	6.2
Cargill Pond A11:	-	-	-	-	-	-
Cargill Pond A12:	0.4	0.4	0.4	1.6	1.6	1.6
Cargill Pond A13:	-	0.5	0.5	1.2	1.6	1.6
Cargill Pond A15:	-	0.4	0.4	-	0.4	0.5
Cargill Pond A16:	-	-	-	-	-	-
Cargill Pond A17:	-	-	-	-	-	-
Cargill Pond A3(East):	0.1	0.1	0.1	0.4	0.4	0.4
Cargill Pond A3(West):	-	-	-	-	-	-

A. Coyote Creek hydrograph has been lagged 11 hours behind Guadalupe River per J.Wang, SCVWD, 4/2000.

B. Construct an engineered weir at Cargill Pond A8W and Alviso Slough, and install five 8-ft diameter tide gates at the bay front levee (northwest) of the FWS Refuge (Pond A6).

C. Brought up the ground surface to a salt marsh plain at approximately mean high water (MHW).

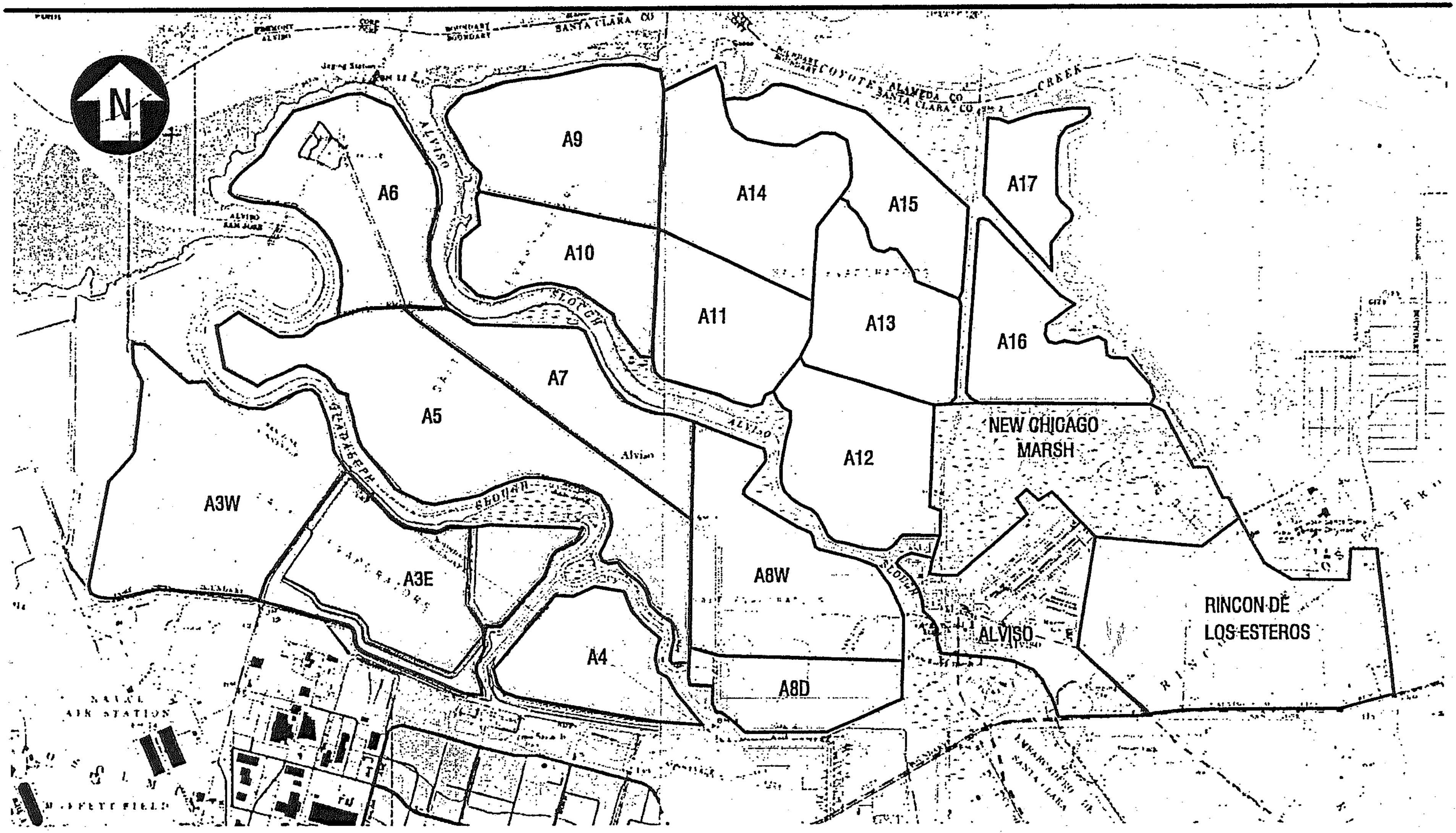
D. Accreted marsh surface effectively brought up the bottom (starting elev.) of the pond.



nhc northwest hydraulic consultants, inc.
3950 industrial boulevard, suite 100c
west sacramento, california 95691
(916) 371-7400

LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
TASK 10 - RECONNAISSANCE STUDY
APPROXIMATE RECON STUDY BOUNDARY

FIGURE
1



LEGEND

A7	CARGILL EVAPORATOR POND NO.
—	APPROXIMATE STORAGE CELL BOUNDARY

nhc

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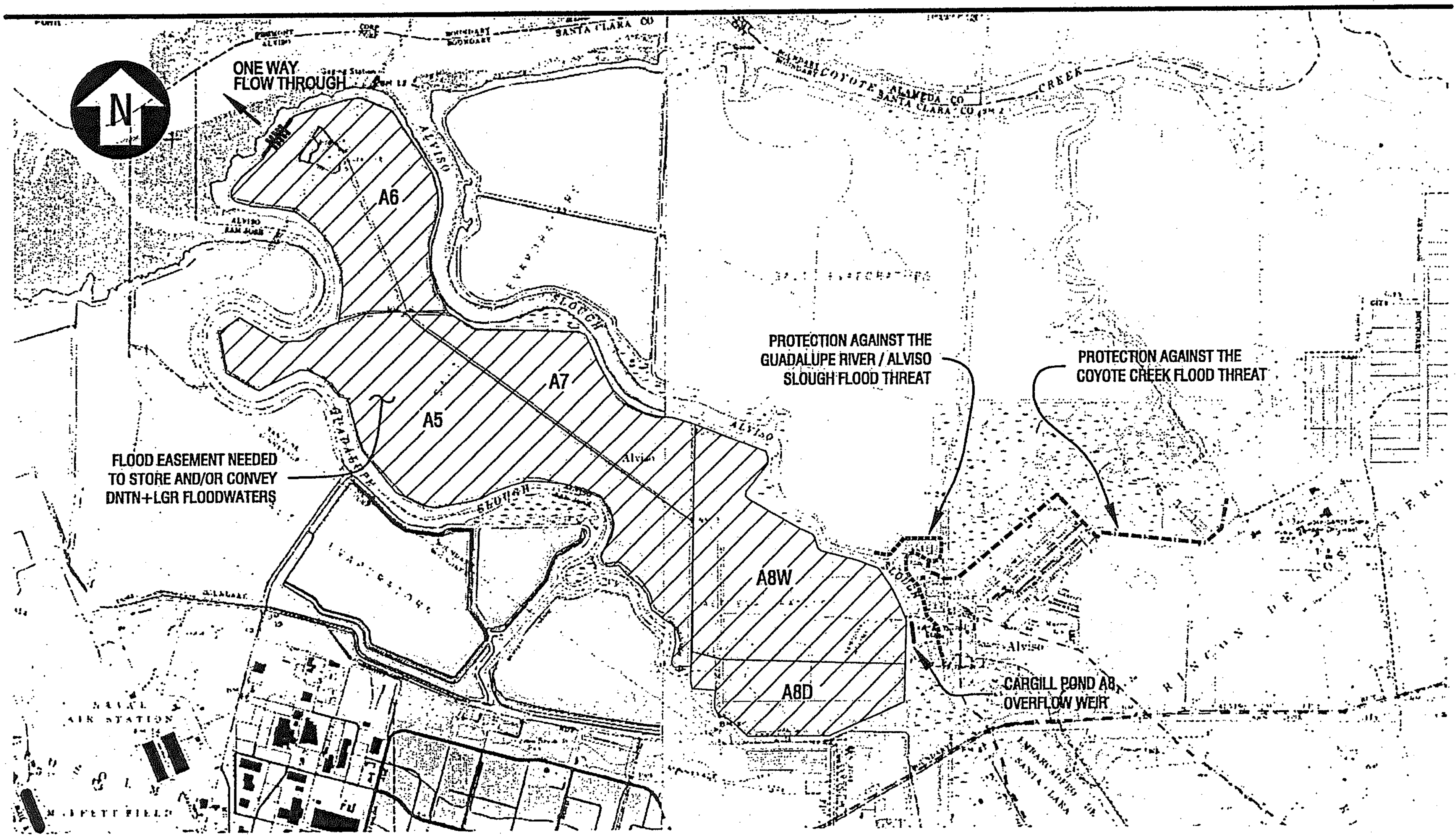
west sacramento, california 95691
(916) 371-7400

LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY
DELINEATED UNET MODEL STORAGE CELLS

FIGURE
2



ONE WAY FLOW THROUGH

FLOOD EASEMENT NEEDED TO STORE AND/OR CONVEY DNTN+LGR FLOODWATERS

PROTECTION AGAINST THE GUADALUPE RIVER / ALVISO SLOUGH FLOOD THREAT

PROTECTION AGAINST THE COYOTE CREEK FLOOD THREAT

CARGILL POND A8 OVERFLOW WEIR

LEGEND

A7	CARGILL EVAPORATOR POND NO.

nhc

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LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY
CONCEPTUAL BAYLANDS IMPROVEMENTS

FIGURE 3

MEMORANDUM

To: **Dave Von Rueden, CH2MHill** Robert C. MacArthur
From: Bob MacArthur, NHC
Date: 10-23-00
Subject: Incremental Baylands Reconnaissance Results

Dear Mr. Von Rueden:

Purpose:
The Figure 1-2 (attached) shows the approximate extent of the Baylands Reconnaissance study area. In June 2000, Northwest Hydraulic Consultants (NHC) submitted a Draft report summarizing the results from our Baylands Reconnaissance Investigation. Following receipt of review comments from the District and additional comments discussed during recent meetings with Dennis Cheong, NHC has performed additional incremental hydraulic analyses of the Baylands study area. Results from these most recent hydraulic analyses are summarized herein.

Methods and Scenarios:
Modeling methodology is essentially the same as discussed in the June 2000, Draft Reconnaissance Report and is based on readily available information. Some recent model refinements have been made where some additional topographic information has been found. Four sets of results are presented herein for the following scenarios:

1. **Present-Day Conditions - No** Guadalupe River flood control improvements and **no** Baylands improvements.

2. *Upstream Flood Improvements Only; No Pumping* - **With** Guadalupe River Flood Control Improvements Upstream of UPRR (includes Downtown and LGR improvements), but **No Baylands Improvements** and **No stormwater pumping** into LGR

3. *Upstream Flood Improvements Only; With Pumping* - **With** Guadalupe River Flood Control Improvements Upstream of UPRR (includes Downtown and LGR improvements), but **No Baylands Improvements** and **With stormwater pumping** into LGR.

4. ***Baylands and Upstream Flood Improvements; With Pumping* - With** Baylands improvements and Guadalupe River Flood Control Improvements Upstream of UPRR (includes minimum Baylands flood mitigation components, Downtown and LGR improvements), **With stormwater pumping** into LGR.

Detailed descriptions for each incremental modeling run within the four sets of general scenarios are summarized below. Results from each model run are presented in Tables 1 through 4 according to the same labeling protocol used below. Figure 4-9 (attached) delineates key locations where modeling results presented in Tables 1 through 4.

1. Present-Day Conditions (see* Table 1:*) - No Guadalupe river flood control improvements and no Baylands improvements.

Present-Day Conditions: **(PD)**	Guadalupe River at max channel capacity, Q = 14K cfs 10-yr tide at Dumbarton Brdg 100-yr hydrographs on Tribs, Coyote Q_p lagged 11 hours No Downtown Flood Control Project Improvements No LGR Flood Control Project Improvements No Baylands Improvements Cargill Ponds still operated as salt ponds; no ponds filled

Description of Scenarios Considered for Incremental Analyses for Present-Day Conditions:

PD1 (Present Day - 1)	Guadalupe River at max channel capacity, Q = 14K cfs,etc. No effects of N. First Street flooding into Alviso [If interior drainage pumping can not occur or keep up with storm runoff, excess flows can enter Alviso through the First Street corridor.] No Coyote improvements; Coyote can still flood Alviso Overflow occurs into Cargill A8W ponds for Q_{GR}>6,800cfs
PD2 (Present Day - 2)	Guadalupe River at max channel capacity, Q = 14K cfs,etc. No effects of N. First Street flooding into Alviso No Coyote improvements; Coyote can still flood Alviso Overflow into Cargill A8W ponds ***can not occur***
PD3 (Present Day - 3)	Guadalupe River at max channel capacity, Q = 14K cfs,etc. No effects of N. First Street flooding into Alviso ***With*** Coyote improvements; ***NO Coyote flooding to Alviso*** Overflow occurs into Cargill A8W ponds for Q_{GR}>6,800cfs
PD4 (Present Day - 4)	Guadalupe River at max channel capacity, Q = 14K cfs,etc.

No effects of N. First Street flooding into Alviso
With Coyote improvements; ***NO Coyote flooding to Alviso***
Overflow into Cargill A8W ponds ***can not occur***

PD5 (Present Day -5)

Guadalupe River at max channel capacity, Q = 14K cfs,etc.
Flooding from N. First into Alviso CAN occur from flows breaking out of the Guad river u/s of Hwy 237
With Coyote improvements; ***NO Coyote flooding to Alviso***
Overflow occurs into Cargill A8W ponds for Q_{GR}>6,800cfs

2. ***Upstream Flooding Improvements Only*** **(see Table 2) - With** Guadalupe River Flood Control Improvements Upstream of UPRR (includes Downtown and LGR improvements), but **No Baylands Improvements** and **No pumping** into LGR

US Fld Imprv'mnts Only
With No Pumping:
(USFINP)

Guadalupe River Q_P = 17K cfs, ***No pumping into LGR***
10-yr tide at Dumbarton Brdg
100-yr hydrographs on Tribs, Coyote Q_p lagged 11 hours
With Downtown Flood Control Project Improvements
With LGR Flood Control Project Improvements
No Baylands Improvements
Cargill Ponds still operated as salt ponds; no ponds filled

Description of Scenarios Considered for Incremental Analyses for *Upstream Flood Control Improvements Only, No Baylands improvements and no pumping into LGR:*

USFINP-1 (US Fld Imp Only-1)

Guadalupe River Q_P = 17K cfs, etc., no pumping into LGR
No effects of N. First Street flooding into Alviso [If interior drainage pumping can not occur or keep up with storm runoff, excess flows can enter Alviso through the First Street corridor.]
With Coyote improvements; No Coyote flooding to Alviso
Overflow occurs into Cargill A8W ponds for Q_{GR}>6,800cfs

USFINP-2 (US Fld Imp Only-2)

Guadalupe River Q_P = 17K cfs, etc., no pumping into LGR
Flooding from N. First into Alviso CAN occur from ponded interior drainage not being pumped into LGR
With Coyote improvements; **No** Coyote flooding to Alviso
Overflow into Cargill A8W ponds *occur*s

USFINP-3 (US Fld Imp Only-3)

Guadalupe River Q_P = 17K cfs, etc., no pumping into LGR

No effects of N. First Street flooding into Alviso
No Coyote improvements; **Coyote can still flood Alviso**
Overflow occurs into Cargill A8W ponds for Q_{GR}>6,800cfs

USFINP-4 (US Fld Imp Only-4)	Guadalupe River Q_P = 17K cfs, etc., no pumping into LGR ***Flooding from N. First into Alviso CAN occur*** from ponded interior drainage not being pumped into LGR **No** Coyote improvements; **Coyote can still flood Alviso** Overflow into Cargill A8W ponds *occur*s
USFINP-5 (US Fld Imp Only-5)	Guadalupe River Q_P = 17K cfs, etc., no pumping into LGR **No effects** of N. First Street flooding into Alviso ***With*** Coyote improvements; ***NO Coyote flooding to Alviso*** Overflow into Cargill A8W ponds ***can not occur***
USFINP-6 (US Fld Imp Only-6)	Guadalupe River Q_P =17K cfs, no pumping into LGR **No effects** of N. First Street flooding into Alviso **No** Coyote improvements; **Coyote can still flood Alviso** Overflow into Cargill A8W ponds ***can not occur***

3. ***Upstream Flood Improvements Only*** **(Table 3) - With** Guadalupe River Flood Control Improvements Upstream of UPRR (includes Downtown and LGR improvements), but **No Baylands Improvements** and **With pumping** into LGR.

US Fld Imprv'mnts Only, With Pumping: (USFIWP)	Guadalupe River Q_P = 20K cfs, ***With pumping into LGR*** 10-yr tide at Dumbarton Brdg 100-yr hydrographs on Tribs, Coyote Q_p lagged 11 hours With Downtown Flood Control Project Improvements With LGR Flood Control Project Improvements No Baylands Improvements Cargill Ponds still operated as salt ponds; no ponds filled

Description of Scenarios Considered for Incremental Analyses for *Upstream Flood Control Improvements Only, with pumping into LGR and No Baylands improvements:*

USFIWP-1 (US Fld Imp W P-1)	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso [If interior drainage pumping can not occur or keep up with storm runoff, excess flows can enter Alviso through the First Street corridor.]

	No Coyote improvements; **Coyote can still flood Alviso** Overflow into Cargill A8W ponds ***can occur***
USFIWP-2 (US Fld Imp W P-2)	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso **No** Coyote improvements; **Coyote can still flood Alviso** Overflow into Cargill A8W ponds ***can not occur***
USFIWP-3 (US Fld Imp W P-3)	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso ***With*** Coyote improvement; ***NO Coyote flooding to Alviso*** Overflow into Cargill A8W ponds ***can not occur***
USFIWP-4 (US Fld Imp W P-4)	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso ***With*** Coyote improvements; ***NO Coyote flooding to Alviso*** Overflow into Cargill A8W ponds ***can occur***
USFIWP-5 (US Fld Imp W P-5)	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso **No** Coyote improvements; **Coyote can still flood Alviso** Overflow into Cargill A8W ponds ***can occur***, however, Ponds A-5 thru A-8 **have been converted to salt marsh** (no storage)
USFIWP-6 (US Fld Imp W P-6)	Guadalupe River Q_P = 20K cfs, with pumping into LGR **Peak flows on other tributaries reduced to 10-yr event** No effects of N. First Street flooding into Alviso **No** Coyote improvements; **Coyote can still flood Alviso** Overflow into Cargill A8W ponds ***can occur*** and ponds A-5 thru A-8 are still operated as salt ponds

4. Baylands and Upstream Flood Improvements (**see Table 4) - With** Baylands improvements and Guadalupe River Flood Control Improvements Upstream of UPRR (includes minimum Baylands flood mitigation components, Downtown and LGR improvements), **With pumping** into LGR.

BL&US Fld Imprv'mnts, With Pumping: (BL&USI)	Guadalupe River Q_P = 20K cfs, ***With pumping into LGR*** 10-yr tide at Dumbarton Brdg 100-yr hydrographs on Tribs, Coyote Q_p lagged 11 hours

With Downtown Flood Control Project Improvements
With LGR Flood Control Project Improvements
With Baylands Improvements
Cargill Ponds still operated as salt ponds; no ponds filled

Description of Scenarios Considered for Incremental Analyses for *Baylands and Upstream Flood Control Improvements, with pumping into LGR:*

BL&USI-1	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso [If interior drainage pumping can not occur or keep up with storm runoff, excess flows can enter Alviso through the First Street corridor.] **No** Coyote improvements; **Coyote can still flood Alviso** Overflow into Cargill A8W ponds ***can occur***, no imprv'nts **Alviso Marina area levee improvements are built**
BL&USI-2	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso **With** Coyote improvements; ***NO Coyote flooding to Alviso*** Overflow into Cargill A8W ponds ***can occur***, no imprv'nts **Alviso Marina area levee improvements are built**
BL&USI-3	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso **With** Coyote improvements; ***NO Coyote flooding to Alviso*** Overflow into Cargill A8W ponds ***can occur*** **Alviso Marina area levee improvements are built, and Improvements are made to the inlet and outlets weirs in the Cargill Ponds A8W, etc.**
BL&USI-4	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso **No** Coyote improvements; **Coyote can still flood Alviso** Overflow into Cargill A8W ponds ***can occur***, no imprv'nts **Alviso Marina area levee improvements are built** **Cargill Ponds A-5 thru A-8 are converted to a marsh plain at MHW.**
BL&USI-5	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso **With** Coyote improvements; ***NO Coyote flooding to Alviso*** Overflow into Cargill A8W ponds ***can occur***, no imprv'nts

	Alviso Marina area levee improvements are built **Cargill Ponds A-5 thru A-8 are converted to a marsh plain at MHW.**
BL&USI-6	Guadalupe River Q_P = 20K cfs, with pumping into LGR No effects of N. First Street flooding into Alviso **With** Coyote improvements; ***NO Coyote flooding to Alviso*** Overflow into Cargill A8W ponds ***can occur***, no imprv'nts **NO Alviso Marina area levee improvements** **Cargill Ponds A-5 thru A-8 are converted to a marsh plain at MHW.**

Discussion of Results

1. ***Present-Day Conditions*** results are summarized in **Table 1.** Column PD1 shows potential depths of flooding at various key locations (see Figure 4-9, attached) assuming Guadalupe River flows are at river conveyance capacity of approximately 14,000 cfs with no upstream flood control improvements in the downtown area or in the LGR reach and no Baylands improvements. Depths of flooding in Alviso are approximately 5 feet deep. Column PD2 demonstrates how important the present spills into the Cargill ponds west of Alviso are. Comparing PD1 with PD3 shows how vulnerable Alviso is to flooding from Coyote Creek and areas north and east of town. Note that eliminating the Coyote flood threat does not eliminate flooding in Alviso from Guadalupe River. PD4 shows that if flood improvements are made on the Coyote side of Alviso and the opportunity to spill excess Guadalupe River flows into the Cargill ponds west of town is eliminated, flooding in Alviso will still be approximately 3 feet deep from Guadalupe River flows. PD1 through PD4 all assume that there are no contributions to flooding in Alviso (almost 9 feet) from interior drainage entering town down North First Street. PD 5 shows the potential effects of "backdoor flooding" into Alviso from North First Street if flows on the Guadalupe were 20,000 cfs upstream of Hwy 237 and spilled out of the channel just upstream of Hwy 237. This vulnerability from First Street flooding could become even more dramatic for flows that exceed the ultimate channel design capacity of the proposed LGR flood control project. Construction of a ring levee south of Alviso to protect it from potential First Street flooding may only provide partial protection to the town and is more likely to create additional flooding to those properties just south of such a ring levee, and require pumping to handle those interior drainage problems.

2. Results for those conditions that include ***Upsteam Flood Improvements Only and No Pumping*** are summarized in **Table 2.** Column USFINP-3 represents what could possibly occur today if upstream improvements (the downtown and LGR projects, with no pumping) are made with no improvements to prevent Coyote flooding and no Baylands improvements made to the Guadalupe River or Cargill ponds. Depths of flooding in Alviso with no upstream pumping (USFINP-3) are approximately 5 feet deep. USFINP-1 shows the effects of eliminating additional flooding from Coyote Creek. Flooding in Alviso is still on the order of 1 foot deep.

USFINP-1 shows that Coyote creek improvements are likely to induce flooding to the ponds north of Alviso, thus requiring possible flood easements there as well. USFINP-2 shows the effects that potential First Street flooding contributions could make (an additional 5 to 6 feet deeper in town), even with no Coyote Creek flood contributions. USFINP-4 shows the effects that potential First Street flooding contributions could make in combination with the added effects of Coyote Creek flood contributions. USFINP-5 shows how critically important it is to spill excess flows into the Cargill ponds west of town (ponds A5 -A8). Note also that if spills can not occur into the west ponds A5- A8, spills are forced to occur into the ponds north of Alviso, with the possibility of entering town once they have filled. USFINP-6 shows the cumulative effects of no improvements to prevent Coyote flooding and no ability to spill into ponds A5 - A8. Flood depths in Alviso and the New Chicago Marsh area are approximately 7 feet deep.

3. Results for those conditions that include ***Upsteam Flood Improvements Only With Pumping Into LGR*** are summarized in **Table 3**. USFIWP-1 represents what could possibly occur today if upstream improvements (the downtown and LGR projects, with pumping) are made with no improvements to prevent Coyote flooding and no Baylands improvements made to the Guadalupe River or Cargill ponds. Depths of flooding in Alviso and the New Chicago Marsh area (USFINP-1) are approximately 5.5 feet deep. Depths of flooding in Ponds A5 through A8 go up another two feet from those depths computed for the same scenario in Table 2 (see USFINP-3), without pumping. Depths of flooding in Alviso deepen to 7 feet deep (see USFIWP-2) if spilling can not occur into ponds A5-A8. USFIWP-2 also shows that if spill into ponds A5-A8 can't occur, then excess water spills into the ponds north of town (ponds A11-A15). The effects of Coyote Creek improvements are shown in column USFIWP-4. Depths of flooding in Alviso are on the order of 1.5 to 2 feet deep, but depths of flooding in Cargill ponds A12-A15 increase significantly. USFIWP-3 shows the effects of making Coyote Creek improvements but not being able to spill into ponds A5-A8; e.g., depths of flooding in Alviso are on the order of 7.5 to 8 feet.

All previous runs and scenarios assumed present conditions for all Cargill ponds. For the run USFIWP-5, we have assumed that someone has converted all of the Cargill ponds A5-A8 into tidal salt marsh with a bottom elevation at MHW. Spills into these areas can occur, but the effects of eliminating the initial flood storage provided under present conditions is shown to be about ½ to 1 foot of additional flooding in the Alviso and New Chicago Marsh areas. This also causes additional flooding into ponds A12 and A13 and increases the breakout flows to the west into ponds A3. USFIWP-6 shows the effects of assuming a less-prudent set of tributary boundary conditions with only a 10-year flood occurring on Coyote Creek and Guadalupe Slough tributaries. Depths of flooding into Alviso and the New Chicago Marsh areas are still approximately 3 to 4 feet deep with depths of flooding into ponds A5-A8 on the order of 7.5 to 10 feet deep. Some spill still occurs into pond A12.

4. Results for those conditions that include ***Baylands and Upsteam Flood Improvements With Pumping Into LGR*** are summarized in **Table 4**. Column BL&USI-1 summarizes the conditions that might occur during the design event (20,000 cfs) if a flood control levee were built along the right bank of the Guadalupe River and through the County Marina to prevent Guadalupe River flows from overtopping from the west of town. Up to 5 feet of flooding may still occur in Alviso, even with such a levee if no improvements are made to prevent flooding from Coyote Creek Assuming that no interior drainage flows enter town from North First Street, flooding in Alviso is eliminated by building the Marina levee and flood improvements to prevent flooding from Coyote (see BL&USI-2). Note that for BL&USI-2 there is still a requirement to obtain flood easements for those ponds north of town because flooding is induced in ponds A12, A13 and A15. BL&USI-3 represents the combined effects of building the Marina levee, eliminating Coyote flooding effects and improving the inlet and outlet efficiency for spills entering ponds A5-A8. If Coyote improvements are not made and only the Marina levee is constructed and ponds A5-A8 become tidal salt marsh areas with no other engineered improvements, then BL&USI-4 shows that flooding in Alviso and the New Chicago Marsh areas are on the order of 5 to 7 feet deep. Depths of flooding over the new marsh plain in ponds A5-A8 range from 4.5 to 7 feet deep. Column BL&USI-5 shows the effects of the Marina levee with Coyote improvements and ponds A5-A8 becoming tidal salt marsh areas with no other engineered improvements. New Chicago Marsh floods to a depth of about 7 feet, but no significant flooding occurs in Alviso. Ponds A12, A13 and A15 will require additional flood easements for scenario BL&USI-5. If Coyote improvements are made, but no Marina levee is built and ponds A5-A8 become tidal salt marsh areas with no other engineered improvements, then approximately 2.6 to 7 feet of flooding occurs in the Alviso and New Chicago Marsh areas. Ponds A12, A13 and A15 flood and will require additional flood easements for scenario BL&USI-6 as well. Scenarios BL&USI-4, BL&USI-5 and BL&USI-6 will all affect Cargill ponds A3 to the west.

Summary

Following are key summary points based on results from the Baylands Reconnaissance Investigation

- Alviso and the New Chicago Marsh areas are at risk of flooding from three primary sources: (1) Guadalupe River flows overtopping present-day levees upstream and/or west of Alviso, 2) Coyote Creek flooding from the north, and 3) overland flow down North First Street.

- If interior drainage pumping along the First Street corridor can not occur or keep up with storm runoff or flows that break out of the Guadalupe River, excess flows can enter directly into Alviso through the First Street corridor.

- Without Bayland improvements, flooding in Alviso and New Chicago Marsh from the Guadalupe River worsens as Guadalupe River flows increase due to flood control improvements associated with the downtown and LGR projects.

- Without Bayland improvements, flooding into other private and federal lands (pond areas west and north of Alviso) from the Guadalupe River worsens as Guadalupe River flows increase due to flood control improvements associated with the downtown and LGR projects.

- Increasing Guadalupe River flows from 14,000 to 20,000 cfs at UPRR results in approximately a four-fold increase in flood depths in Alviso (with no flooding contributions from Coyote Creek, see PD3 & USFIWP-4) and approximately doubles the depths of flooding into the private and federal lands west and north of Alviso.

- Cargill ponds A5, A7, A8 are subject to flooding under present-day conditions (4.5 to 7 feet above present pond elevations for Q_{Guad}=14K cfs) and the depths of flooding increase in A5-A8 as Guadalupe River flows increase (8 to 10 feet above present pond elevations for Q_{Guad}=20K cfs)

- If no flooding is allowed into ponds A5-A8 in the future (e.g., no spill is allowed into ponds A5-A8), then flooding in Alviso and the New Chicago Marsh area is significantly increased (7 to 8 feet in Alviso). It is essential to acquire all necessary flood easements through private and federal ponds.

- In the future if no spills are allowed into ponds A5-A8 and the downtown and LGR projects and Coyote Creek improvements were all in place, the estimated water surface elevation at the peak of the design event near the Alviso Yacht Club across from the low weir area is about 17 feet (NAVD 88). Adding 5 feet of freeboard to this for a coastal levee design, would require a levee crest at about 22 feet (NAVD 88) to protect Alviso from Guadalupe River design flows. Refer to the attached Alviso Slough - Plate 1.

- If the Cargill ponds A5-A8 are converted to salt marsh and spills are allowed to occur over the new marsh plain area, a levee to protect Alviso would have to be at least 19.5 feet (NAVD 88). See attached Alviso Slough- Plate 2.

- When ponds A5-A8 are converted to salt marsh, the design event results in a stage increase near the mouth of Guadalupe Slough resulting in induced flooding into pond A3 East. (See USFIWP-5; BL&SUI-4, 5, 6.)

- The USF&WS refuge in pond A6 is vulnerable to inundation for flood flows greater than 14,000 cfs on the Guadalupe River. Special flood easements with the USF&WS may be required. The potential for inundating other USF&WS ponds north of Alviso (ponds A12, 13, 15) for various flooding scenarios is also demonstrated herein. Duration of flooding impacts in these areas can not be determined from available information.

- Snowy Plover habitat in Cargill pond A8(dry) is vulnerable to inundation under present-day conditions as well as future with-project conditions. The range of flooding varies from 1.5 feet deep to 8 feet deep. The duration of flooding can not be determined from available information, but means for pumping those areas dry may be required as future mitigation for these areas.

- Installing Coyote Creek improvements to protect Alviso increases flooding into Cargill ponds A12, 13 and 15, thus possibly requiring additional flood easements.

Limitations and Assumptions

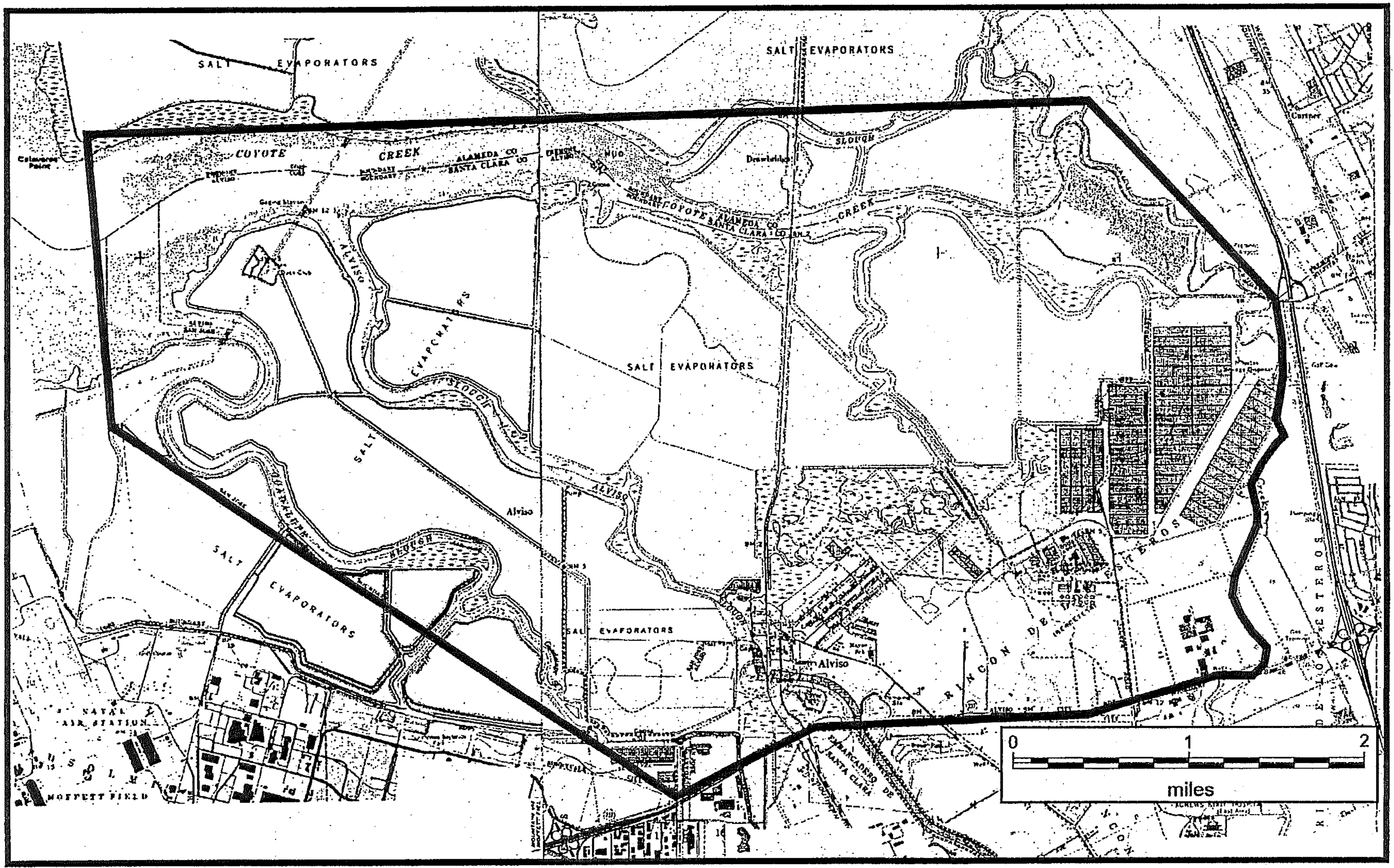
Following are key assumptions and limitations associated with the reconnaissance study results. Additional data and analyses are necessary to refine these preliminary results into planning level information necessary to better determine project performance, costs and potential environmental impacts.

- All results are based on available information
- Reliable topography is lacking for the Baylands study area
- All runs and scenarios assumed present-day conditions for all Cargill ponds unless otherwise stated
- Flooding impacts to Alviso from the First Street corridor are estimated from published FEMA information and very simplified volume routing procedures
- Results for all of the Bayland improvements scenarios are based solely on conceptual improvements. Further detailed data and analyses are required to develop reliable flood mitigation features, cost estimates and environmental impacts
- We assumed no levee failures during all events evaluated. Failures will dramatically change these results. Most of the levees in the Bayland area are unengineered private levees with unknown geotechnical characteristics
- We did not consider levee settlement, channel accretion or subsidence
- We did estimate the effects of 1 foot of sea level rise at the Dumbarton Bridge. This results in approximately one foot of water surface rise near Alviso for all flooding scenarios.
- All analyses herein assume no antecedent effects from previous storm events. Historical flow records show that it is likely, however, to have significant events occurring prior to a rare event. It is therefore necessary to provide adequate methods to drain ponds A5-A8 prior to the next event.
- All of our analyses show how very sensitive computed water surface elevations are to small changes in land surface and levee elevations. More detailed topography is required prior to further analyses or design.
- We can't forecast future levee conditions due maintenance or the lack of maintenance on the private levees.
- Future project performance will depend on whether present levees continue to be stable for all future conditions and flows.
- For most of the scenarios presented we have assumed that all necessary flood easements have been obtained.
- If interior drainage pumping along the First Street corridor can not occur or keep up with storm runoff or flows that break out of the Guadalupe River, excess flows can enter directly into Alviso through the First Street corridor.
- For all scenarios we assume resource agencies responsible for managing those areas subject to flooding will allow future, and perhaps deeper flooding to occur.

FIGURES, TABLES AND PLATES

referenced in the Memo

See following pages



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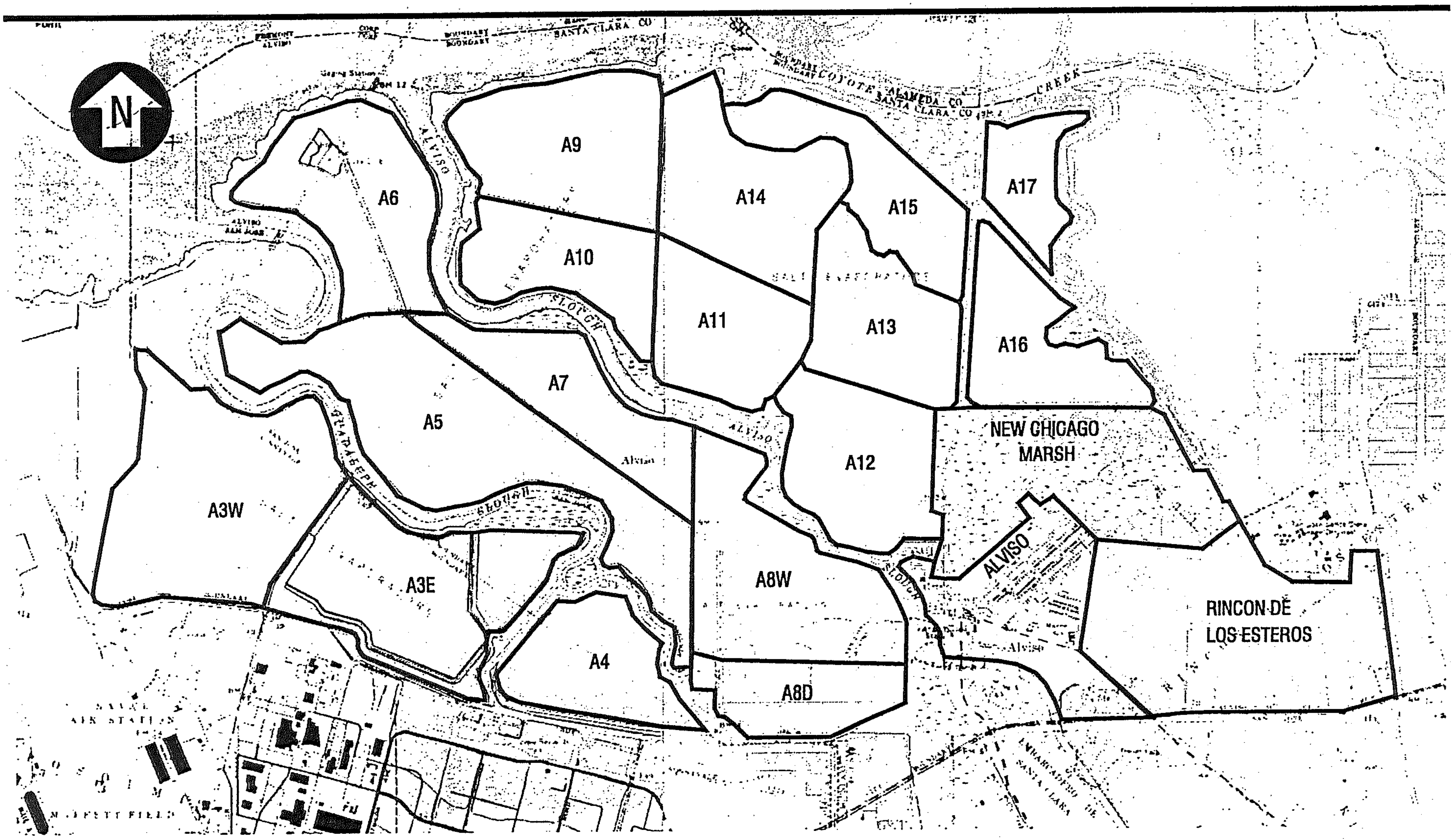
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
TASK 10 - RECONNAISSANCE STUDY
APPROXIMATE RECON STUDY BOUNDARY

FIGURE
1-2



LEGEND

A7 CARGILL EVAPORATOR POND NO.

——— APPROXIMATE STORAGE CELL BOUNDARY

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LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY
DELINEATED UNET MODEL STORAGE CELLS

FIGURE
4-9

TABLE 1
PRESENT-DAY CONDITIONS
(No LGR or DNTN Projects built; No Baylands Improvements)

BAYLANDS BOUNDARY CONDITIONS

Scenario:	PD1	PD2	PD3	PD4	PD5
Lower Guad Flowrate:	14,000	14,000	14,000	14,000	14,000
Dumbarton Tide:	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr
Other Tributaries[A]*:*	100-Yr	100-Yr	100-Yr	100-Yr	100-Yr
N.First St. Overland Flows:	0	0	0	0	6,000
Coyote Creek Improvements:	No	No	Yes	Yes	Yes
Cargill A8W Overflow:	Yes	No	Yes	No	Yes
Cargill A5-A8 is a Marsh:	No	No	No	No	No

ESTIMATED INUNDATION DEPTHS (ft)

Location:	PD1	PD2	PD3	PD4	PD5
Alviso:	4.8[B]	5.8[B]	0.3[B]	2.9[B]	8.8[C]
New Chicago Marsh:	4.8[B]	5.8[B]	4.8[B]	7.0[B]	5.3[C]
Rincon De Los Esteros:	-[B]	-[B]	-[B]	-[B]	2.8[C]
Cargill Pond A5:	4.5	2.6	4.5	4.1	4.5
FWS Pond A6:	-	-	-	-	-
Cargill Pond A7:	4.5	3.0	4.5	3.0	4.5
Cargill Pond A8(Wet):	6.9	1.7	7.4	1.7	7.4
Cargill Pond A8(Dry):	4.4	1.5	4.5	1.5	4.5
Cargill Pond A11:	-	-	-	-	3.1
Cargill Pond A12:	-	1.0	-	1.0	3.7
Cargill Pond A13:	-	-	0.4	0.5	4.1
Cargill Pond A15:	-	-	0.4	0.4	1.4
Cargill Pond A16:	-	-	-	-	-
Cargill Pond A17:	-	-	-	-	-
Cargill Pond A3(East):	0.1	0.1	0.1	0.1	0.1
Cargill Pond A3(West):	-	-	-	-	-

A. Coyote Creek hydrograph has been lagged 11 hours behind Guadalupe River per J.Wang, SCVWD, 4/2000.

B. Excludes the depth associated with inundation due to overland flooding from N. First Street.

C. Inundation is the greater of either river overflows, or N. First Street overland flooding.

TABLE 2
LOWER GUADALUPE RIVER AND DOWNTOWN PROJECTS ONLINE
(No San Jose Stormwater Pumping into LGR; No Baylands Improvements)

BAYLANDS BOUNDARY CONDITIONS

Scenario:	USFINP-1	USFINP-2	USFINP-3	USFINP-4	USFINP-5	USFINP-6
Lower Guad Flowrate:	17,000	17,000	17,000	17,000	17,000	17,000
Dumbarton Tide:	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr
Other Tributaries[A]:	100-Yr	100-Yr	100-Yr	100-Yr	100-Yr	100-Yr
N.First St. Overland Q:	0	3,000	0	3,000	0	0
Coyote Creek Improvements:	Yes	Yes	No	No	Yes	No
Cargill A8W Overflow:	Yes	Yes	Yes	Yes	No	No
Cargill A5-A8 is a Marsh:	No	No	No	No	No	No

ESTIMATED INUNDATION DEPTHS (ft)

Analysis Results:	USFINP-1	USFINP-2	USFINP-3	USFINP-4	USFINP-5	USFINP-6
Alviso:	0.7^{B}	6.5^{C}	4.9^{B}	6.5^{C}	6.3^{B}	6.8^{B}
New Chicago Marsh:	7.0^{B}	7.0^{C}	5.0^{B}	5.0^{C}	7.0^{B}	6.8^{B}
Rincon De Los Esteros:	$-^{B}$	0.3^{C}	$-^{B}$	0.3^{C}	0.1^{B}	0.5^{B}
Cargill Pond A5:	5.7	5.7	5.7	5.7	3.3	3.3
FWS Pond A6:	5.6	5.6	5.6	5.6	-	-
Cargill Pond A7:	5.7	5.7	5.8	5.8	3.2	3.3
Cargill Pond A8(Wet):	8.3	8.3	8.3	8.3	4.5	4.5
Cargill Pond A8(Dry):	6.0	6.0	6.0	6.0	2.1	2.2
Cargill Pond A11:	-	-	-	-	-	-
Cargill Pond A12:	0.1	0.1	-	-	2.0	1.8
Cargill Pond A13:	0.5	0.5	-	-	2.2	2.2
Cargill Pond A15:	0.4	0.4	-	-	0.4	0.1
Cargill Pond A16:	-	-	-	-	-	-
Cargill Pond A17:	-	-	-	-	-	-
Cargill Pond A3(East):	0.1	0.1	0.1	0.1	0.1	0.1
Cargill Pond A3(West):	-	-	-	-	-	-

A. Coyote Creek hydrograph has been lagged 11 hours behind Guadalupe River per J.Wang, SCVWD, 4/2000.

B. Excludes the depth associated with inundation due to overland flooding from N. First Street.

C. Inundation is the greater of either river overflows, or N. First Street overland flooding.

TABLE 3
LOWER GUADALUPE RIVER AND DOWNTOWN PROJECTS ONLINE
(Includes Stormwater Pumping into LGR; Excludes Baylands Improvements)

BAYLANDS BOUNDARY CONDITIONS

Scenario:	USFIWP-1	USFIWP-2	USFIWP-3	USFIWP-4	USFIWP-5	USFIWP-6
Lower Guad Flowrate:	20,000	20,000	20,000	20,000	20,000	20,000
Dumbarton Tide:	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr
Other Tributaries[A]:	100-Yr	100-Yr	100-Yr	100-Yr	100-Yr	10-Yr
N.First St. Overland Q:	0	0	0	0	0	0
Coyote Creek Improvements:	No	No	Yes	Yes	No	No
Cargill A8W Overflow:	Yes	No	No	Yes	Yes	Yes
Cargill A5-A8 is a Marsh:	No	No	No	No	Yes	No

ESTIMATED INUNDATION DEPTHS (ft)

Analysis Results:	USFIWP-1	USFIWP-2	USFIWP-3	USFIWP-4	USFIWP-5	USFIWP-6
Alviso:	5.3	7.0	7.6	1.6	5.8	3.0
New Chicago Marsh:	5.3	7.0	7.0	7.0	6.6	3.8
Rincon De Los Esteros:	-	0.7	1.3	-	-	-
Cargill Pond A5:	7.8	3.4	3.5	7.8	5.1[D]	7.4
FWS Pond A6:	7.7	-	-	7.7	4.4[D]	7.2
Cargill Pond A7:	7.8	3.4	3.4	7.8	5.1[D]	7.4
Cargill Pond A8(Wet):	10.2	5.7	5.7	10.2	6.7[D]	9.7
Cargill Pond A8(Dry):	7.8	3.4	3.3	7.8	6.2	7.4
Cargill Pond A11:	-	2.6	2.3	-	-	-
Cargill Pond A12:	0.3	3.4	3.2	0.3	1.5	0.2
Cargill Pond A13:	-	3.8	3.5	0.5	0.6	-
Cargill Pond A15:	-	1.2	0.5	0.4	-	-
Cargill Pond A16:	-	-	-	-	-	-
Cargill Pond A17:	-	-	-	-	-	-
Cargill Pond A3(East):	0.1	0.1	0.1	0.1	0.3	-
Cargill Pond A3(West):	-	-	-	-	-	-

A. Coyote Creek hydrograph has been lagged 11 hours behind Guadalupe River per J.Wang, SCVWD, 4/2000.

B. Excludes the depth associated with inundation due to overland flooding from N. First Street.

C. Inundation is the greater of either river overflows, or N. First Street overland flooding.

D. Accreted marsh surface effectively brought up the bottom (starting elev.) of the pond.

TABLE 4
LOWER GUADALUPE RIVER AND DOWNTOWN PROJECTS ONLINE
(Includes San Jose Pumping into LGR; Includes Baylands Improvements)

BAYLANDS BOUNDARY CONDITIONS

Scenario:	BL&USI-1	BL&USI-2	BL&USI-3	BL&USI-4	BL&USI-5	BL&USI-6
Lower Guad Flowrate:	20,000	20,000	20,000	20,000	20,000	20,000
Dumbarton Tide:	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr	10-Yr
Other Tributaries[A]:	100-Yr	100-Yr	100-Yr	100-Yr	100-Yr	100-Yr
N.First St. Overland Q:	0	0	0	0	0	0
New Alviso Marina Levee:	Yes	Yes	Yes	Yes	Yes	No
Coyote Creek Improvements:	No	Yes	Yes	No	Yes	Yes
Cargill A8W Overflow:	Yes	Yes	Yes	Yes	Yes	Yes
Improved[B] inflow and outflow for A5-A8:	No	No	Yes	No	No	No
Cargill A5-A8 is a Marsh[C]:	No	No	No	Yes	Yes	Yes

ESTIMATED INUNDATION DEPTHS (ft)

Analysis Results:	BL&USI-1	BL&USI-2	BL&USI-3	BL&USI-4	BL&USI-5	BL&USI-6
Alviso:	4.8	-	-	4.8	-	2.6
New Chicago Marsh:	4.8	7.0	7.0	6.6	7.1	7.0
Rincon De Los Esteros:	-	-	-	-	-	-
Cargill Pond A5:	8.0	8.0	7.3	5.1[D]	5.1[D]	5.1[D]
FWS Pond A6:	7.8	7.8	7.0	4.4[D]	4.4[D]	4.4[D]
Cargill Pond A7:	8.0	8.0	7.3	5.1[D]	5.1[D]	5.1[D]
Cargill Pond A8(Wet):	10.3	10.3	9.7	6.7[D]	6.7[D]	6.7[D]
Cargill Pond A8(Dry):	8.0	8.0	7.4	6.2	6.2	6.2
Cargill Pond A11:	-	-	-	-	-	-
Cargill Pond A12:	0.4	0.4	0.4	1.6	1.6	1.6
Cargill Pond A13:	-	0.5	0.5	1.2	1.6	1.6
Cargill Pond A15:	-	0.4	0.4	-	0.4	0.5
Cargill Pond A16:	-	-	-	-	-	-
Cargill Pond A17:	-	-	-	-	-	-
Cargill Pond A3(East):	0.1	0.1	0.1	0.4	0.4	0.4
Cargill Pond A3(West):	-	-	-	-	-	-

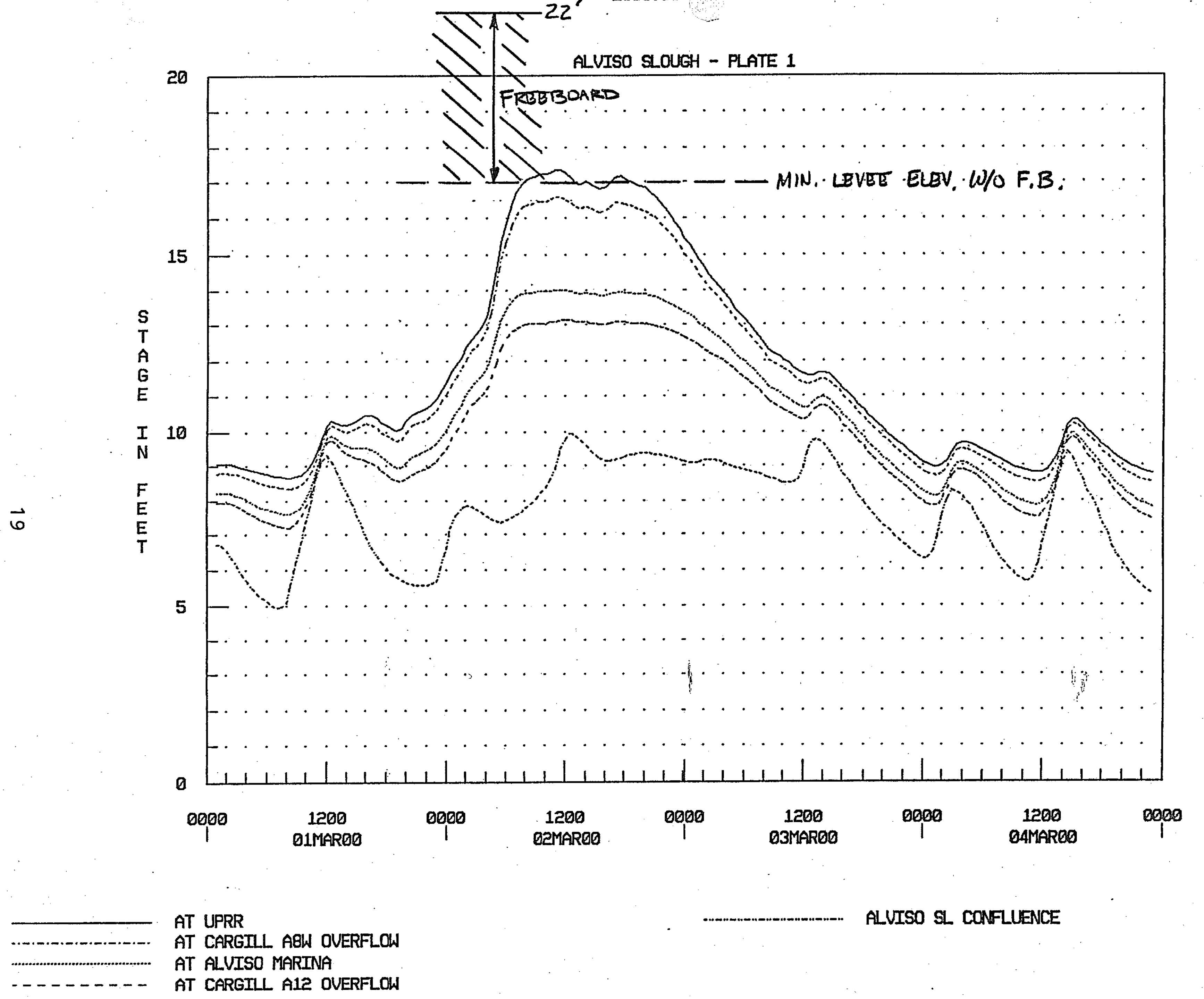
A. Coyote Creek hydrograph has been lagged 11 hours behind Guadalupe River per J.Wang, SCVWD, 4/2000.

B. Construct an engineered weir at Cargill Pond A8W and Alviso Slough, and install five 8-ft diameter tide gates at the bay front levee (northwest) of the FWS Refuge (Pond A6).

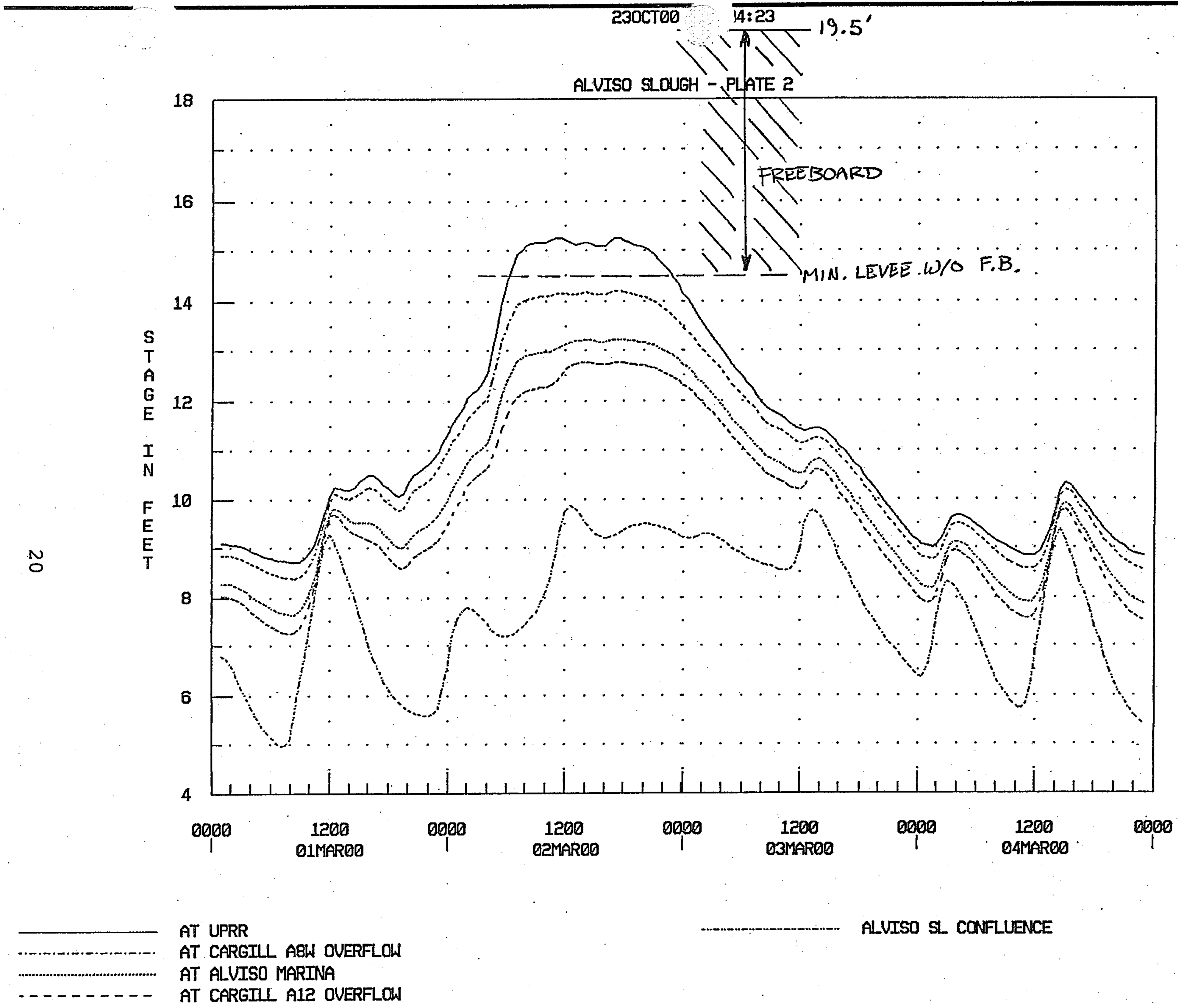
C. Brought up the ground surface to a salt marsh plain at approximately mean high water (MHW).

D. Accreted marsh surface effectively brought up the bottom (starting elev.) of the pond.

ALVISO SLOUGH - PLATE 1



USFIWP-3



ALVISO SLOUGH - PLATE 2

USFIWP-5

RECONNAISSANCE
REPORT

Final Reconnaissance Report

Engineering and Environmental Reconnaissance Studies Of the River Reach from UPRR to the Bay Lower Guadalupe River Project, California

Santa Clara Valley Water District

Prepared by:
northwest hydraulic consultants, inc.

Prepared for:
CH2M Hill

September 2000

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Appendix A. Environmental Setting and Natural Resources

Executive Summary

This Reconnaissance Study is part of the "Lower Guadalupe River Flood Protection Project (LGRFPP)", being conducted by the Santa Clara Valley Water District (SCVWD). This study addresses potential Guadalupe River flood impacts on Alviso Slough and the existing salt ponds in the baylands, and develops conceptual alternative solutions to mitigate flood hazards downstream of the Lower Guadalupe River Project.

PURPOSE

The purpose or objective of this Reconnaissance Study is to:

- ☐ *Identify existing flood risks to Alviso and the surrounding baylands area as a result of (a) Guadalupe River flows, and (b) other potential sources;*
- ☐ Identify whether alternatives exist to reduce flood risks identified in the study area;
- ☐ If alternatives exist, develop them to a Reconnaissance level (conceptual) only. Future planning and design activities will be required prior to final design, final environmental assessment and construction;
- ☐ Identify data needs and tasks required to proceed to the next level of study.

These objectives are addressed in this Reconnaissance Study Report. This study determined that a risk of flooding does exist in Alviso and the in surrounding baylands area both from high flows from the Guadalupe River as well as other sources. The reconnaissance analyses identified viable hydraulic solutions to reduce the flood risk to Alviso, Federal and Private lands and businesses, and surrounding nearby environmental resources. Reconnaissance-level concepts (alternatives) to reduce flood risks were developed and evaluated for their ability to reduce both flooding and potential environmental impacts in the study area.

The recommended concept for further analysis and refinement includes the following key components:

- ☐ *Acquisition of flood easements to Ponds A5, FWS Refuge (A6), A7, A8W and A8D. Fee acquisition of these lands would provide additional future opportunities of joint stewardship and land use with other interested parties.*
- ☐ *Installation of an engineered levee overtopping structure (flow control weir) on Alviso Slough's west levee across from the Town of Alviso to secure predictable and managed overtopping into ponds A5 through A8 to the west from high flow events occurring in Guadalupe River.*
- ☐ *Installation of flow control outlet structure(s) at the northwest ends of ponds A5-A7 near the FWS Refuge to allow discharge of stored flood flows during periods of low tide.*
- ☐ *Installation of discharge pump(s) to dewater critical environmental areas (like Pond A6 and A8D) after flood events.*
- ☐ *Construction of levee improvements to the levied areas west and north of Alviso past the County Marina to eliminate Guadalupe River induced flood flows from entering town.*
- ☐ *Improvements to Pond A8D to provide year-round snowy plover habitat (details need to be determined during the next phase of study in cooperation with appropriate resource agencies and the landowners).*

This study identified additional data needs and unresolved issues requiring further study. Future design activities need to address these issues prior to construction of any significant improvements. A summary of additional needs is provided at the end of this Executive Summary. Following is a summary of findings from the Baylands Reconnaissance Study.

The Problem

Under present-day conditions, Alviso and the surrounding baylands are vulnerable to flooding from many directions and sources, including the Guadalupe River. The Guadalupe River can deliver river flows on the order of 14,000 to 20,000 cfs during a design flood to Alviso Slough just downstream of the UPRR Bridge. Results from this study conclude that Alviso Slough does not have the capacity to carry current high flows that can reach the slough, nor the project design flood (20,000 cfs), without spilling a portion of the flow to the west into Ponds A5 to A8. Under existing conditions, excess flood flows in Guadalupe River upstream of Alviso can overtop existing east bank levees and flood northward along North First Street which slopes directly toward the town of Alviso. In addition to the Guadalupe River flood risk, Coyote Creek and Guadalupe Slough also have the potential to overtop local levees and contribute to flooding in the Alviso/baylands area. Extreme high flows on Coyote Creek can direct floodwaters into and through New Chicago Marsh to Alviso and/or Rincon de Los Esteros between Alviso and the Treatment Plant to the east. Construction of flood control projects planned for the Lower Guadalupe River and Downtown Guadalupe reaches will increase the existing Lower Guadalupe River channel capacity from approximately 14,000 cfs to 20,000 cfs, thereby increasing the magnitude of possible flood flows being delivered to Alviso and the baylands area. Valuable tidal marsh habitat areas along the Alviso and Guadalupe Sloughs are also susceptible to impacts from flooding that may increase due to the construction of upstream flood control improvements. Planning and design of flood improvements need to consider potential impacts to these critical habitat areas.

Results

The town of Alviso is vulnerable to flooding from many directions and from many sources of floodwaters. The degree of flooding ranges from a few feet under present day conditions predominantly from North First Street flood flows to as much as 5-8 feet of potential flooding entering through the County Marina Parking Lot once the Lower Guadalupe River and Downtown Guadalupe River Projects are completed.

Alviso Slough lacks the capacity to convey present-day peak inflow from Guadalupe River and cannot contain the increased peak discharge for the design event The present-day capacity in Alviso and Guadalupe Sloughs is less than approximately 10,000 to 11,000 cfs, each. Alviso Slough can adequately convey around 6,800 cfs before flows begin overtopping a low spot along the west bank and discharging into pond A8. The Guadalupe River can deliver approximately 13,000-14,000 cfs to Alviso Slough under present-day channel conditions, thus exceeding the existing capacity of Alviso Slough even with flow spilling into pond A8. Once the Downtown and Lower Guadalupe River projects are completed the present day Alviso Sough will be incapable of containing the increased design flow from the flood control projects unless some improvements are made in the baylands downstream of the UPRR Bridge at Alviso.

Traditional means for increasing channel capacity, such as raising the levees from UPRR to the bay, or dredging of Alviso Slough, are not suitable in this case. Present slough levees are non-engineered structures with potentially inadequate foundation materials, limiting their ability to be adequately raised without significant expense. Raising the existing levees would likely require their complete demolition and replacement with new, higher levees requiring much larger foundations to support their weight in the bay mud environment. Environmental impacts to the Alviso Slough habitat and special status species could be significant, and expensive to mitigate. In addition, with the increased design flows, these structures would be required to be several feet higher than present-day levees near Alviso. Raising the levees in the baylands to contain and carry all flood flows to the bay will raise the water surface elevations in the baylands reach and cause higher water surface elevations upstream of UPRR. The resulting higher water surfaces upstream of UPRR will require the levees upstream of UPRR to also be heightened which is likely to lead to increased construction costs and more maintenance and environmental mitigation expenses.

Tidal processes and marsh accretion (daily sediment deposition in the slough channels) precludes the option of dredging. Dredging costs have to include initial capital costs, mitigation for initial impacts, and long-term frequent maintenance and environmental mitigation costs for re-dredging. A prime example of the extent and rate of sediment accumulation that occurs in this area exists at the County Marina at Alviso, which was abandoned due to the inability to perform maintenance dredging and is now completely filled in with sediment. Merely dredging the channel deeper does not improve hydraulic conveyance from UPRR to the bay because the entire dredged conveyance area is tidally submerged.

Due to the lack of channel capacity in Alviso Slough a combination of several flood mitigation components is required to reduce the threat of Guadalupe River flooding to the Town of Alviso and baylands area. Primary components include: (i) improvements to the west Alviso Slough levee and marina parking lot from UPRR bridge to downstream of the County Marina; (ii) construction of an engineered overflow weir on the west bank of Alviso Slough adjacent to pond A8D; (iii) obtaining flood easements for Ponds A5, A6, A7, A8W and A8D; and (iv) construction of outlet facilities or pump stations to evacuate floodwaters from Cargill ponds A5, A6, A7 and A8 following flood events. Installation of these four combined mitigation components will reduce flooding to the east of Alviso Slough. Construction of upstream flood improvements, including the Lower Guadalupe River and Downtown Flood Control Projects, will reduce flood risks along the North First Street corridor from flows breaking out of the Guadalupe River upstream of UPRR Bridge. However, management of Guadalupe River flows alone will not eliminate other sources of flooding risks to Alviso and the baylands. Therefore, if the ultimate goal is to eventually reduce all risks of flooding to Alviso and the baylands, additional regional planning and design is required, and is beyond the scope of this investigation.

Results from this study determined that the lands (salt ponds) between Alviso and Guadalupe sloughs are a vital component of any flood management solution. Historically, these lands were marshlands open to the bay and tidal processes. They were diked off for salt production in the early part of the 20th century. These lands are presently owned by private corporations such as Cargill Salt Company, or are Federal lands owned by the U.S. Fish & Wildlife Service. Periodic utilization of these lands as overflow detention is critical to any practical baylands flood control solution. Construction of high containment levees and/or channel dredging downstream of UPRR Bridge are not practical solutions. Therefore, the ability to complete and operate both the Downtown Guadalupe River Project and the Lower Guadalupe River Project to their respective capacities is entirely dependent upon accessibility of these baylands as a component of flood control.

Results from this study indicate that additional flood mitigation improvements are required in the baylands to protect Alviso, the County Marina, numerous Cargill salt ponds, U.S. Fish and Wildlife Refuge property, and other local public and private infrastructure in the baylands area, from increased flows that will be delivered from the combined Lower Guadalupe River and Downtown Guadalupe River Flood Control Projects. This reconnaissance study identifies several potential (conceptual) alternatives for mitigating flood risks downstream of the UPRR Bridge. However, advanced planning and design studies for the baylands are recommended to refine and substantiate a buildable solution.

CONSTRAINTS

Ongoing natural processes are diminishing the conveyance capacity of the local tidally influenced sloughs. These processes include marsh accretion or sediment deposition onto the tidal marshes and in the slough channels, gradual sea level rise, potential future land subsidence, and growth or propagation of marsh vegetation inboard of slough levees that will increase flow resistance and accelerate sediment accretion inboard of slough levees. Baylands hydraulic conditions are complicated by the fact that several watercourses all discharge into the same baylands area, which is tidally influenced. These watercourses include Coyote Creek, Mud Slough, Artesian Slough, Alviso Slough, San Tomas Acquino Creek, Calabazas Creek, Sunnyvale East and Sunnyvale West Drains, and the South San Francisco Bay tide. The change in tide stage in the project area from mean lower low water (MLLW) to mean higher high water (MHHW) is in excess of nine (9) feet. This very complicated hydraulic boundary condition requires more specialized consideration than traditional steady-state stream hydraulics. In addition, valuable habitat that supports threatened and/or listed endangered species is known to be in the area, which may complicate structural alternatives for mitigating flood risks. Also complicating the assessment of eventual mitigation of flood risks is the fact that all the baylands downstream of the UPRR bridge are private or federally owned properties with a variety of intended uses, none of which include flood control at this point.

In order to develop an acceptable solution for the baylands, the preferred alternative(s) must either design around these constraints, or be capable of mitigating or complying with these constraints. Solutions must be long-term and capable of functioning now and well into the future with the likelihood of minimal maintenance.

OPPORTUNITIES

This reconnaissance-level study utilized readily available information to identify potential opportunities for reducing flood risks to Alviso, Cargill salt ponds and the surrounding baylands area between Gold Street and UPRR trestle to the South Bay. In addition, this Reconnaissance Study has qualitatively assessed a range of alternatives, and recommends a practical, realistically achievable alternative to reduce/mitigate flood risks to Alviso and the baylands, while minimizing potential environmental impacts. Recommendations are summarized on the following page.

LIMITATIONS

Although this Reconnaissance Study had qualitatively identified possible solution(s), there are limitations associated with the results and conclusions derived from this assessment. They include the following:

- The study objective was to assess flood risks and develop conceptual solutions at a reconnaissance level, utilizing only existing and/or readily available data – some of which are very old and possibly obsolete;
- The results from this study are not suitable for design or construction of a flood control project in the baylands due to data limitations and level of analyses. Additional data and further design studies are required prior to construction;
- This study and its results and conclusions are only a first step toward planning, design, and eventually constructing flood control improvements in the baylands;
- The hydraulic processes in the baylands are largely influenced by daily tidal conditions and are, therefore, very sensitive to small changes in land surface elevation and/or water surface elevation. Much of the topographic data available for this study are antiquated and can range in elevation accuracy by more than a foot which can significantly affect computed results;
- The hydraulic response of the baylands is greatly influenced by the existing levees and salt ponds. Modification of these features to fulfill future changing land use needs will change local hydraulic conditions. It was is beyond the scope of this investigation to investigate potential effects of future land use changes and/or improvements that may be implemented by land owners. Impacts due to future land use modifications must be investigated by the landowners;
- Present day as well as future levee stability characteristics have not been investigated;
- This Reconnaissance Study has identified environmental habitat and species of concern in the baylands region, along with an estimate of baseline conditions. However, it does not include detailed assessment of project impacts, or respective mitigation responsibilities, avoidance, replacement or mitigation/enhancement quantities;

- The study recommends some methods for reducing flood risks in the baylands, but has not attempted to address acceptability of the recommendations with the present land owners.

CH2M Hill will provide preliminary cost estimates for the recommended reconnaissance-level alternative under separate reporting.

CONCLUSIONS

Key conclusions from this reconnaissance investigation are:

- Alviso and surrounding private and public lands are highly susceptible to flooding today, and the flood risk is likely to worsen in the future due to sea level rise and man-induced changes in peak flow and watershed conditions upstream;
- It is essential to obtain flood easements for salt ponds A5 through A8 (including A6) as part of any flood mitigation solution in the baylands study area. Obtaining the flood easements becomes even more important once the Lower Guadalupe River and Downtown Guadalupe River Flood Control Projects come on line because peak flows delivered to the baylands may increase from 14,000 to 20,000 cfs during the design event;
- This Reconnaissance Study has identified the flood risks and conceptual components of a flood mitigation plan for the baylands. Additional data and more detailed analyses are required to develop more comprehensive plans, designs and the necessary environmental (EIR/EIS) documentation required to implement a flood control project in the baylands.

RECOMMENDATIONS

The ability to manage flows during a design event flood along the Lower Guadalupe River and Alviso Slough (peak flows up to 20,000-cfs) requires a combination of baylands flood mitigation components including: (i) obtaining flood easements to temporarily store excess flood waters from Alviso Slough in Cargill salt ponds A5, A6, A7, A8W and A8D, and the FWS Refuge (formerly pond A6), (ii) construction of an engineered overflow weir on the west bank of Alviso Slough adjacent to pond A8D; (iii) constructing improvements to the west Alviso Slough levee and marina parking lot from UPRR bridge to downstream of the County Marina; and (iv) constructing outlet facilities or pump stations to evacuate floodwaters from Cargill ponds A5 through A8 following flood events. The following recommendations are aimed at managing Guadalupe River flood flows (up to the 20,000 cfs design event) from UPRR to the South Bay:

- Acquire flood easements for Ponds A5, A6 (FWS Refuge), A7, A8W and A8D.
- Install an engineered levee overtopping structure (flow control weir) on Alviso Slough's west levee across from the Town of Alviso to provide predictable overtopping flows into ponds A5 through A8 during major flood events.
- Install flow release tide gate structure(s) at the northwest end of the FWS Refuge to allow managed release of stored flood waters during periods of low tide.
- Determine if pumping is necessary to de-water critical environmental areas (like pond A8D or A6).
- Construct levee improvements west and north of Alviso along Alviso Slough and the County Marina to eliminate Guadalupe River induced flood flows from entering town.
- If Pond A8D is to be used for flood storage, then construct some elevated knolls or high features in the southwest corner to provide year-round snowy plover habitat (the details of such a plan can be determined in next study phase in cooperation with appropriate resource agencies). Optionally, a

levee can be constructed to separate Pond A8D from A8W such that Alviso Slough overtopping flood flows cannot inundate A8D.

- This study raises the awareness of backdoor flooding to Alviso from New Chicago Marsh and the New Chicago Marsh Canal. Further investigation of these sources of flooding to Alviso and the baylands may be necessary during future planning studies.

More up-to-date data are necessary and additional detailed studies are required to evaluate the baylands hydraulic conditions at a level of detail acceptable to develop designs, and to successfully complete environmental documentation (EIR and/or EIS). Therefore, this study recommends consideration of the following future activities:

- Gather new and missing data (such as new channel and slough geometry, levee profiles, salt pond topography for the interior berms and pond inverts, geotechnical data for the levees, tide data in Alviso Slough, seasonal suspended sediment concentration data, and measurements to determine of constituents such as mercury are found in the baylands study area.)
- Perform a more comprehensive (quantitative) engineering and environmental assessment of flood risks and associated impacts, including impacts to critical habitat features;
- Prepare prudent baylands design criteria;
- Coordinate design plans with stakeholders and landowners; anticipate future conversion of the salt ponds to different types of land uses in the baylands;
- Complete the required environmental documentation (EIR/EIS) and associated hydraulic analyses, sedimentation assessments and other studies necessary to complete the EIR/EIS.

1 INTRODUCTION AND BACKGROUND

1.1 THE PROBLEM

The town of Alviso and the nearby Cargill salt ponds are susceptible to flooding from all directions, and from different sources. Alviso is vulnerable to Guadalupe River flooding from the south along North First Street as well as from the County Marina to the northwest. Alviso is also vulnerable to flooding from the north and east from excess Coyote Creek floodwaters that enter, and pass through New Chicago Marsh or the Rincon de Los Esteros region to the east. In fact, Alviso has been threatened or flooded several times in recent history (1955, '58, '82, '83, '95 and 1998). And, without periodic reparations or improvements to the Alviso Slough levee on the west edge of town, gradual sea level rise coupled with continued subsidence results in a tidal flood risk.

Cargill salt ponds are vulnerable to flooding from Guadalupe River flood flows, Guadalupe Slough flood flows chiefly from San Tomas Acquino and Calabazas Creeks, and Coyote Creek floodwaters. The estimated present-day conveyance capacity in Alviso Slough is around 6,800 cfs, and around 6,500 cfs in Guadalupe slough. Both capacities represent less than about a 10-year event (estimated at 13,500 cfs). Cargill ponds were flooded as recently as 1995 and 1998. In addition, the conveyance capacity in these sloughs is slowly diminishing further due to marsh accretion processes (sediment deposition) and salt marsh vegetation growth in the sloughs.

Numerous complex constraints dictate how the baylands area functions presently for flood control versus its former function prior to significant land development. The former function of the entire area was that of tidal marsh whereby terrestrial flood flows would enter this marshland and spread out significantly as floodwaters made their way to the bay. The complex constraints depicting present day conditions have removed this former function entirely. These complexities include: a) removal of several thousand acres of marshland for solar salt production, b) marsh accretion processes in the sloughs, c) significant land subsidence, d) gradual sea level rise, e) marsh vegetation growth in the sloughs, f) a nine-foot range in tide amplitude, and g) several major waterways discharging to essentially the same location.

Under present day conditions, rivers and creeks upstream of Alviso and the baylands area can already deliver more flood flows than the local sloughs can accommodate resulting in periodic flooding. Guadalupe River can convey up to 14,000 cfs to UPRR and Gold Street; Alviso Slough can only carry about 6,800 cfs before overtopping commences. Construction and operation of Lower Guadalupe River and Downtown Guadalupe River Projects would deliver considerably more floodwaters (20,000 cfs) to Alviso Slough and the baylands. Because there is likely a very significant induced flood risk by operating these projects, the Lower Guadalupe River Project and the Downtown Guadalupe River Project flood impacts need to be identified, quantified and mitigated in order to safely discharge Guadalupe River flood waters to the bay. Thus, a study was needed to investigate the viability of reasonable, viable opportunities to manage this potential flood risk.

1.2 STUDY PURPOSE

The Lower Guadalupe River Reconnaissance Study is part of a larger investigation, the "Lower Guadalupe River Flood Protection Project (LGRFPP)", being conducted by the Santa Clara Valley Water District (SCVWD). The purpose of the LGRFPP investigation is to evaluate existing and potential flooding problems on the Guadalupe River from Interstate 880 downstream (northward) to the Union Pacific Railroad (UPRR) crossing at Alviso, California. The LGRFPP also addresses the Guadalupe River flood impacts on Alviso Slough and the existing salt ponds in the baylands and develops alternative solutions to mitigate flood hazards within the Lower Guadalupe River study reach. A general map of the lower Guadalupe River showing the LGRFPP reach is presented in Figure 1-1. Figure 1-2 depicts the baylands area specific to this Reconnaissance investigation, which is contiguous to the LGRFPP.

According to the Scope of Work, the purpose of this Reconnaissance Study is:

- *Identify existing flood risks to Alviso and the surrounding baylands area as a result of (a) Guadalupe River flows, and (b) other potential sources;*
- *Identify whether alternatives exist to reduce flood risks identified in the study area;*
- *If alternatives exist, develop them to a Reconnaissance level (conceptual) only. Future planning and design activities will be required prior to final design, final environmental assessment and construction;*
- *Identify data needs and tasks required to proceed to the next level of study.*

The "Baylands" area generally includes all portions of Guadalupe River and Alviso Slough hydraulic system subject to tidal influence, as well as the community of Alviso and surrounding area (where ground elevations lie roughly around sea level).

1.3 STUDY AREA

As Figure 1-2 depicts, the Recon study area is bounded as follows:

To the South:	Guadalupe River and Highway 237;
To the East:	Zanker Road, San Jose-Santa Clara Water Pollution Control Plant (WPCP or Treatment Plant), and Artesian Slough;
To the North:	Coyote Creek;
To the West:	Guadalupe Slough.

As shown in the figure, much of the baylands historically subjected to tidal processes has been removed from tidal access, having been converted to solar salt production by private businesses between 1900 and the present. As part of the development of the San Jose/Santa Clara Water Pollution Control Plant (Treatment Plant), the lands from the plant westward, including Alviso, were annexed into the San Jose city limits in 1968. The community of Alviso therefore presently lies within the San Jose city limits.

The study area is a complex system that must be evaluated using a system-wide approach. Historically, the baylands area was essentially all tidal salt marsh. Guadalupe River (and other streams too) would discharge their flood flows onto this broad marsh plain where the floodwaters would spread out and eventually make their way to the bay. This former function has been completely removed, and flood flows are now concentrated into very confined, inadequate channelized corridors. Seven hydraulic boundary conditions (South Bay tides, Guadalupe River, Coyote Creek including Artesian Slough, San Tomas Acquino Creek, Calabazas Creek, Sunnyvale East and Sunnyvale West drainages) influence flows throughout the baylands in addition to numerous geographical and man-made features (salt pond levees, Alviso and Guadalupe Slough levees, New Chicago Marsh canal, UPRR facilities, Treatment Plant, Town of Alviso, etc.). All of these systems share a common discharge location. This project has labeled this common (shared) region as the "baylands". Each individual hydraulic boundary contributes flood flows to or impacts this "common" area. Flood protection solutions will focus primarily on diminishing or eliminating the flood risk induced by the Guadalupe River. However, these same Guadalupe River based solutions must not preclude possible additional future solutions to flood risk from other sources (Coyote Creek; San Tomas Acquino Cr., Calabazas Cr.; etc.) impacting the Reconnaissance area.

1.4 RECENT PRIOR STUDIES

The following are brief descriptions and results of recent studies conducted in, or contiguous to the Reconnaissance study area:

- In 1998 Northwest Hydraulic Consultants, Inc. performed a pre-reconnaissance level investigation, "*Preliminary Geomorphic and Hydrodynamic Assessment of the Guadalupe River, Alviso Slough, Guadalupe Slough and Its Tributaries, and the Cargill Salt Pond System*." As the title implies, the purpose was to assess the geomorphic and hydrodynamic processes affecting the same area encompassed by this present Reconnaissance study at a very preliminary level. The study assisted in defining potential flood problems, and investigated and assessed possible alternatives for re-routing flow and improving levees. The evaluation focused on opportunities for improving flood control, the effects of flow re-routing on salt pond operations, and possibilities for enhancing habitat values in the study area. Preliminary-level Alviso Slough marsh accretion analyses were performed by R.B. Krone and Associates (R.B. Krone, 1998a). In May 1998, results were presented to the staff and managers of Santa Clara Valley Water District and Cargill Salt Division.

  Results indicated that, for various degrees of flood-flow passage between Alviso and Guadalupe Slough and/or through Cargill ponds A5-A8, reductions in design water surface elevation could be realized. It was shown that the water surface elevation near Alviso could be lowered by as much as 2 meters (about 6.5 feet) depending on the combination of re-routing scenarios. Results of the marsh accretion analysis provided a more precise understanding of the processes of marsh building, and the degree of dynamic response that marsh accretion can exhibit in a dramatically changing environment (subsidence, sea level rise, etc.).

- Also in 1998, Northwest Hydraulic Consultants, Inc. performed a more detailed hydraulic sensitivity assessment for Santa Clara Valley Water District and Cargill Salt Division, "*Hydraulic Sensitivity Assessment of Alviso and Guadalupe Sloughs*." The purpose of this assessment was to develop a more accurate understanding of the maximum capacity in the sloughs that could be achieved without inducing flooding into the Town of Alviso and impacting sensitive environmental habitat, all the while reducing the flood risk to the Cargill salt ponds. The program was phased to evaluate Alviso Slough first, and then Guadalupe Slough. Preliminary-level Guadalupe Slough marsh accretion analyses were performed by R.B. Krone and Associates (R.B. Krone, 1998b). In addition, new levee profiles for Alviso Slough were obtained along with six cross-sections. The levee profiles allowed the hydraulic sensitivity assessment to reflect up-to-date levee maintenance/repairs by Cargill. The cross-sections were surveyed to compare to sections taken by the Water District in late 1995.

  Results indicated that the capacity of Alviso Slough was significantly less than the anticipated design flood from Guadalupe River, and that the capacity near Alviso was also very sensitive to the tides. Nearing a bank-full flow condition, a one-foot drop in tide stage at the confluence with Coyote Creek is approximately equivalent to a 1,000 cubic feet per second (cfs) increase in channel capacity near Alviso. Results also indicated that levee improvements made to protect the salt ponds would possibly inducing flooding into the Town of Alviso. Although the study originally focused on both Alviso and Guadalupe Sloughs, because of these results further assessment of Guadalupe Slough was discontinued.

- In 1996, Jones and Stokes Associates performed a comprehensive watershed study, "*Santa Clara Valley Water District Guadalupe River Watershed Planning Study*," for the Santa Clara Valley Water District. Its purpose included identifying the desires of the community and the District, protecting the basin's environmental and economic well-being in the execution of District projects, water supply optimization and contingency supply planning, water quality, and flood damage reduction.

Results published in a January 1997 Engineer's Report identified existing water resource related problems within the Guadalupe River watershed, including water quality and flooding. The report also described on-going water resource management programs, integration of capital improvements, and summarized a wide variety of alternatives and their expected impacts to the watershed.

◆ In 1998, the Department of Civil and Environmental Engineering, University of California at Davis, conducted a marsh restoration study, "*Sediment Transport and Water Quality Modeling of the Knapp Unit of the Don Edward San Francisco Bay National Wildlife Refuge Complex*," for the U.S. Geological Survey Biological Resources Division. The focus of this study was the refuge located at the downstream end of Alviso and Guadalupe Sloughs and Coyote Creek (also known as Salt Pond A6). The study took into account the present elevation of the lands, the South Bay tide, salinity of the tide, suspended sediments in the tidewaters, and hydrodynamic processes that would accrete the site as a result of creating breaches in the present levees surrounding the site.

Results indicated that accretion to a healthy salt marsh could be possible depending upon the size, location and number of openings in the levees. If done properly, circulation would be acceptable and stagnant water avoided. With such a high starting ground elevation, marsh vegetation might develop within the next 5 to 10 years. Invasion of exotic plant species could become an issue in years where high winter flows of fresh water impact the site, creating low-salinity periods.

2 STUDY AREA

2.1 DESCRIPTION

2.1.1 GUADALUPE RIVER

The Guadalupe River contributes storm runoff and flood inflows into Alviso Slough and is therefore an upstream hydraulic boundary condition to the baylands area (see Figure 1-2). Historically, the Guadalupe River continued westerly downstream of the UPRR trestle and out through Guadalupe Slough (Figure 2-1), but presently turns north at this location discharging into Alviso Slough. Guadalupe River from its downstream end at UPRR upstream to approximately Montague Expressway (approximately 12,000 meters or 7.5 mi.) is subject to tidal processes. However, Guadalupe River hydraulic analyses upstream of UPRR are part of the overall LGRFPP Study and outside the scope of the Reconnaissance Study.

2.1.2 ALVISO SLOUGH

Alviso Slough is a tidal slough extending from its confluence with Coyote Creek and South San Francisco Bay upstream to the Guadalupe River at the UPRR trestle. Although historical mapping appears to indicate that some Guadalupe River flows might have overflowed into Alviso Slough (Figure 2-2), the predominant flow in Alviso Slough until the mid-1900s was the conveyance of tidal waters into and out of the tidal marsh northwest of the town of Alviso. Guadalupe River historically discharged into Guadalupe Slough, and subsequently into the Bay. In the early 1900's, the historical Guadalupe River channel was disconnected from Guadalupe Slough by the development of the tidal marsh into salt evaporation ponds. From that time forward, Guadalupe River has relied upon Alviso Slough as its outfall to Coyote Creek and the Bay. The conveyance capacity of Alviso Slough to carry these waters is still affected by the ebb and flow of the tide.

2.1.3 CARGILL SALT EVAPORATORS

The baylands area has been dominated by numerous shallow evaporation ponds scattered throughout the study area since the mid-1900's (Figure 2-3). These shallow ponds are presently owned and operated by Cargill Salt Division in the production of salt for industrial and commercial use. Saltwater is imported from the South Bay west of the study area, and is routed sequentially through numerous cells or salt ponds whereby evaporation increases the salinity of the remaining waters. By the time this resulting brine solution reaches the last evaporator ponds, the remaining water is evaporated away leaving a broad plain of crystalline salt, which is mechanically harvested. The salt ponds in the Reconnaissance Study area are about mid-stage with respect to the entire salt concentration process.

Overtopping of the salt pond perimeter levees from significant flood events on streams in the baylands area causes fresh waters to contaminate and/or dilute the brine solution. This impacts the salt production operations by decreasing the brine salinity, requiring Cargill to retain or hold the water in the diluted ponds for an extended period of time until evaporation can restore the original brine salinity. This can add several months to the typical 5-year period necessary for the overall salt decantation process.

2.1.4 SOUTH SAN FRANCISCO BAY

The confluence of Guadalupe Slough and Coyote Creek forms the approximate demarcation or southern limit of South San Francisco Bay. This is also the downstream hydraulic boundary condition for the Reconnaissance Study. South bay tidal effects and processes extend significantly up Coyote Creek however, as well as up the entire length of Alviso and Guadalupe Sloughs. Tide stage data at Dumbarton Bridge (about 5 miles downstream of the Guadalupe - Coyote confluence) are used to represent this hydraulic boundary condition for the Reconnaissance Study analyses. Dumbarton Bridge generally has sufficient tide records to support its use as representative of the South Bay boundary condition.

2.1.5 PERIPHERAL WATERCOURSES

The entire baylands functions hydraulically as a comprehensive single system. Alviso Slough, Cargill Salt Ponds, and the South Bay are all directly linked to the hydraulic performance of Guadalupe River and its ability to deliver flood flows to the bay. The following watercourses (discussed below) may not directly influence Guadalupe River flood flows, but do have a direct impact on the "shared" floodplains and overflow areas of Guadalupe River (including Cargill facilities). To fully satisfy the study objectives, we must consider the "shared" hydraulic regime that all systems rely upon to transfer flood flows to the bay.

2.1.5.1 Coyote Creek

Coyote Creek represents the northern boundary of this Reconnaissance Study, and is treated as both a boundary condition at the northeastern most point, and as a receiving and conveyance system for outflow from both Alviso and Guadalupe Sloughs. Coyote Creek throughout the entire study area is subject to tidal processes, and thus the ebb and flow of the tide affects its conveyance capacity.

2.1.5.2 Guadalupe Slough

Guadalupe Slough forms the western boundary of the study area, and carries runoff from four tributaries west of Guadalupe River to the bay. The four tributaries discharging into Guadalupe Slough are: San Tomas Acquino Creek, Calabazas Creek, Sunnyvale East and Sunnyvale West Drainage Channels. The confluence of San Tomas Acquino and Calabazas represents the upstream extent of Guadalupe Slough, with the two Sunnyvale drainages entering laterally further downstream. Conveyance capacity of Guadalupe Slough to carry these waters is affected by the ebb and flow of the tide. As stated previously in Section 2.1.2, development of the salt ponds has generally cut off all flows from Guadalupe River.

2.1.5.3 Artesian Slough (Treatment Plant Discharges)

Artesian Slough lies along the eastern margin of the Study area, and represents the hydraulic inflow boundary condition from the WPCP treatment facility discharge. For the purposes of this study, the average constant discharge rate of 160 million gallons per day (mgd) or 247 cubic feet per second (cfs) was used, representing the maximum discharge potential by the treatment plant under wintertime conditions. Daily average summertime discharges are approximately 120 mgd (roughly 186 cfs).

2.2 ENVIRONMENTAL SETTING AND NATURAL RESOURCES

This section provides an overview of the environmental setting and natural resources of the Reconnaissance Study Area. Appendix A contains more detailed information on these topics. Appendix A also contains reference citations for the sources of the information provided below.

2.2.1 CLIMATE

The Santa Clara Valley has a mild Mediterranean climate. Temperatures range from an average high of 82° F in July to an average low of 49° F in January. Average annual precipitation is 36.5 inches per year, with most of the rainfall occurring between October and April. Prevailing winds are northwesterly and average 10 mph.

2.2.2 TOPOGRAPHY AND GEOLOGY

The Reconnaissance Study Area is in the Santa Clara Valley, with the Santa Cruz Mountains on the west and the Diablo Range on the east. Regional topography in the area is largely controlled by faults of the San Andreas system and by contractile (thrust) structures associated with Coast Range uplift. Topography in the Reconnaissance Study Area is relatively flat, with elevations ranging from 3 feet below sea level in portions of New Chicago Marsh to15 feet above sea level in the southeastern portion of the study area. Subsidence by as much as 6 feet in Alviso is a result of extensive groundwater pumping between 1934 and 1967. Depth to bedrock is 2,200–3,500 feet in the Alviso area. The bedrock is overlain by Pleistocene and Holocene alluvium, bay mud, and fluvial deposits, as well as anthropogenic fill materials.

2.2.3 SOILS

Soils of the Reconnaissance Study Area belong to the Alviso series, Mocho series, and Campbell series; areas of "made land" are also present. Much of the Reconnaissance Study Area is underlain by tidal marsh soils of the Alviso series. These are fine-textured, poorly drained soils developed on alluvium derived from sandstone and shale parent rock. Soils of the Guadalupe River and Coyote Creek floodplains are primarily clay loam belonging to the Mocho series. Upland soils along the marshes and salt ponds are considered "made land" and are composed of alkaline fill overlying wetland, marsh, and tidal flat deposits.

2.2.4 LAND USE

Most of the Reconnaissance Study Area is within the City of San Jose but outside the San Jose urban service area. Portions of the Reconnaissance Study Area extend into the Cities of Fremont (northern edge), Milpitas (parcel on eastern edge), and Sunnyvale (parcel at southern tip). There is also an unincorporated parcel in the southeast corner of the Reconnaissance Study Area.

The largest landholdings in the Reconnaissance Study Area coincide with the area's predominant land uses. They include: Cargill's salt ponds; the USFWS Don Edwards San Francisco Bay National Wildlife Refuge's (SFBNWR's) salt ponds, waterways, sloughs, and marshes; and the San Jose/Santa Clara Water Pollution Control Plant's facilities and buffer lands. Other land uses include landfills (Zanker Road, Newby Island, and former Cargill), business parks, vacant land designated for industrial/business park use and related uses, and Alviso Village. Most of the development in the Reconnaissance Study Area is in Alviso Village, which encompasses a mixture of residential, commercial, industrial, and community uses. The general distribution of existing land uses is shown in Figure 2-4. The District is presently pursuing the acquisition of Cargill Pond A4 with the intent of restoring these lands into a wildlife habitat area.

Known future projects on currently undeveloped properties include: Cisco Systems Site 6 Specific Plan (office, research and development, light industry); Legacy Terrace project (office, hotel, commercial, open space); and Highway 237 Assemblage project (office, research and development, commercial).

2.2.5 SOCIOECONOMIC CONDITIONS

According to the 1990 Census, the Alviso area had a population of 2,195, which was predominantly Hispanic (71%, compared to 26% in San Jose as a whole). There were approximately 590 housing units, which included single-family homes, duplexes and triplexes, and small apartment buildings. Housing in Alviso was older and more crowded than in San Jose overall, and a higher proportion of properties in Alviso were rentals rather than owner-occupied.

In 1990, there were an estimated 2,000 jobs in Alviso, and it was estimated that there would be 1,000 additional jobs by 2010. Employers in the area include Alviso Village businesses, the San Jose/Santa Clara Water Pollution Control Plant, the area's landfills, and more recently the offices and business parks in the southern portion of the planning area. Compared to San Jose overall, incomes were lower and more people lived at or below poverty level in 1990.

2.2.6 AIR QUALITY

The Santa Clara Valley is located in the San Francisco Air Basin and is under the jurisdiction of the Bay Area Air Quality Management District (BAAQMD). Pollutants in the San Jose area include ozone, inhalable particulate matter (PM10), oxides of nitrogen (NO_x), and carbon monoxide (CO). Ozone and particulate matter are distributed in relatively equal concentrations over the area, while CO and NO_x are localized-source pollutants. Santa Clara County is currently in non-attainment for both ozone and PM10. NO_x and CO concentrations in the San Jose area have also exceeded state or federal ambient air quality laws in recent years.

The Reconnaissance Study Area contains residential neighborhoods and an elementary school that are classified as sensitive receptor sites (sites occupied by populations that are sensitive or susceptible to the detrimental health effects caused by air pollutants). Major air pollutant emitters in the Reconnaissance Study Area include the Newby Island Landfill, the Zanker Road landfill, and the San Jose/Santa Clara Water Pollution Control Plant, which have been identified by the BAAQMD as Toxic Air Contaminant (TAC) locations. However, although the BAAQMD has received complaints from Alviso residents about odors generated by these facilities, the facilities are not considered a threat to public health. Construction activities also generate particulate matter, as well as emissions from construction equipment, which could affect sensitive receptor sites.

2.2.7 WATER QUALITY

Most of the Reconnaissance Study Area is occupied by commercial salt ponds, and the primary factor influencing water quality in these ponds is salinity, which ranges from 80 to 190 parts per thousand. Other indicators of water quality are the concentrations of suspended solids, chlorophyll a, and dissolved oxygen.

In addition to the salt ponds, other important bodies of water in the Reconnaissance Study Area include the lower Guadalupe River and southern San Francisco Bay. Several bodies of water within the Guadalupe River watershed, including the Guadalupe River and southern San Francisco Bay, have been identified by the State Water Resources Control Board as "impaired" under Section 303(d) of the federal Clean Water Act. Total Maximum Daily Load (TMDL) programs are required for these impaired waters, and the programs are now in various stages of development. Table A-5 in Appendix A lists the pollutants which lead to the "impaired" designation. Mercury contamination is a widespread problem in the Guadalupe River watershed, a legacy of the era in which cinnabar and other mercury ores were mined in the hills of the upper watershed.

An updated 303(d) list for California is scheduled for release in 2002. It may include a siltation listing for the Guadalupe River and a Polycyclic Aromatic Hydrocarbons (PAH) listing for southern San Francisco Bay.

2.2.8 BIOLOGICAL RESOURCES

The Reconnaissance Study Area contains a wide variety of plant communities characteristic of upland, wetland, and riparian habitats over much of the southern San Francisco Bay area. These include: ruderal areas, non-native annual grasslands, agricultural lands, salt ponds, tidal and diked salt marshes, brackish and freshwater marshes, seasonal wetlands, enhanced and constructed wetlands, narrow corridors of natural cottonwood-willow riparian forest and woodland, and riparian re-vegetation sites. Although most of the area's upland and wetland habitats have experienced some degree of anthropogenic disturbance, the area supports populations of at least two special-status plant species (Congdon's tarplant and marsh gumplant), and offers suitable habitat for several others (California sea-blite, hairless popcornflower, and Point Reyes bird's beak).

Data on animal use of the Reconnaissance Study Area are incomplete. Comprehensive field surveys for reptiles and mammals have never been performed in the Reconnaissance Study Area, and detailed field surveys have never been performed for birds in the area's salt ponds. However, despite the lack of detailed field surveys, it is clear that the area offers substantial habitat value to a large and diverse assemblage of animal species. Many invertebrates and fish are resident in the salt ponds, and large numbers of birds forage, roost, bathe and nest in and around the ponds. Ponds A5 and A6 are the nesting site for the largest California gull colony in San Francisco Bay and are the only Bay Area site where the Caspian tern breeds. Both tidal and non-tidal wetlands also support a variety of birds and are an important link in the migratory route of native anadromous fish such as steelhead and chinook salmon. Even the area's most disturbed upland habitats provide foraging opportunities and cover for raptors, passerine birds, and small mammals.

The Reconnaissance Study Area supports resident and breeding populations of several special-status animal species. These include: steelhead, chinook salmon, California clapper rail, western snowy plover, California least tern, burrowing owl, loggerhead shrike, salt marsh common yellowthroat, salt marsh harvest mouse, and possibly also tricolored blackbird and Alameda song sparrow. Other special-status species use habitats in the Reconnaissance Study Area for foraging during migration.

2.2.9 CULTURAL RESOURCES

Alviso, originally established as the embarcadero for Mission Santa Clara and incorporated in 1856, was one of the first California cities. It was an active port that received regular steamship service from San Francisco, and it flourished during the Gold Rush. Both the city's function as a major port and its population declined substantially when the railroad from San Francisco to San Jose opened in 1864.

A records search conducted in February 2000 identified four cultural resources in the Reconnaissance Study Area. These are:

- The Port of Alviso National Historic District, which is listed on the National Register of Historic Places (NRHP);
- The historic ship-building facility at the Port of Alviso, which was recommended
- "Not eligible" for listing on NRHP;
- A prehistoric bowl mortar and fire-cracked rocks, whose eligibility for listing is unknown; and

- A prehistoric midden with artifacts and human remains, which is potentially eligible for listing on NRHP.

2.2.10 RECREATION

A variety of recreational land uses and activities are available in the Reconnaissance Study Area. The SFBNWR provides opportunities for several uses, such as: the Environmental Education Center in New Chicago Marsh; the New Chicago Marsh, Alviso Slough, and Mallard Slough recreation trails; hunting in the northern area near the mouth of Coyote Creek; and the Drawbridge historic area where the Union Pacific Railroad tracks cross Coyote Creek. In addition, the 29-acre Alviso Marina County Park provides picnic tables and affords access to the SFBNWR trails. The County plans to construct a new boat launch, boardwalk, observation deck, sheltered picnic facilities, and other improvements as part of their master plan. Other recreation facilities in Alviso include: the 7.5-acre city-owned Alviso Park, which has a playground, swimming pool, and baseball/soccer field; the South Bay Yacht Club and associated marina; and the Pinhigh Family Golf Center.

Regional recreation trails of the Reconnaissance Study Area include the San Francisco Bay Trail and the trails associated with Don Edwards SFBNWR. Sub-regional trails include pathways along both Coyote Creek and the Guadalupe River. These riparian trails are intended to traverse a major portion of the waterway, connecting several jurisdictions with the Coyote Creek and Guadalupe River watersheds.

3 PROBLEMS AND OPPORTUNITIES

3.1 HISTORICAL FLOODING

3.1.1 TIDAL

Businesses in and around Alviso have had to periodically construct barriers or berms to keep the tidewaters out of their operations and/or facilities. The District, in recent times, has had to modify the levee between the town of Alviso and Alviso Slough in an effort to keep out tidewaters. The business of harvesting salt from evaporation in the South Bay region began about 1850. The demand for salt increased as a result of California's growth from the gold rush. Eventually growing to more than two dozen separate businesses, it became the largest solar salt production region in the country (and still is today as a single company - Cargill Salt Division). As regional growth increased the demand for water, groundwater pumping took a greatly accelerated pace in the Santa Clara Valley. This resulted in significant and increasing subsidence throughout the region, including the Reconnaissance area. The intrusion of the tides due to land subsidence required salt harvesting businesses to build ring levees to hold back the tide. Presently, Cargill maintains some 29,000 acres of solar salt ponds in operation, all protected from the tide by hundreds of miles of levees and berms (Howser, 1999). Continuing subsidence required the town of Alviso to also build a levee along its western boundary to keep out tide waters. The Alviso levee was expanded and improved both by Alviso in the 1950s/1960s, and by the Santa Clara Valley Water District following the 1982-83 and 1995 flood events (see Section 3.2.1).

The historical sea level rise in San Francisco Bay is presently about 2 millimeters (mm; ≅ 0.007 ft.) per year (from the San Francisco, California Presidio tide gage), which projects to roughly 20 centimeters (cm), or almost 0.7 ft, over 100 years (see Figure 3-1). According to the 1995 Intergovernmental Panel for Climate Change (IPCC), the range of sea level rise could be anywhere between 15 to 95 centimeters (cm) over the next 100 years (Johnson, 1995). This range is based on a multitude of climate scenarios including factors for global warming, thermal expansion of the oceans, aerosol usage, land use, and other emissions trends. Globally, the average is about 50 cm per 100 years. Sea level rise could, therefore, account for a tide stage increase of around 20 cm over the next 100 years at the Presidio, San Francisco, California. At present, the tide amplitude at the Presidio and the mouth of the San Francisco Bay is approximately 5.83 feet (between Mean Lower Low Water (MLLW) and Mean Higher High Water (MHHW)). This tide is amplified and attenuated as tidewaters are "squeezed" into the South Bay, and even more so further up into Alviso Slough where the same tide cycle now has an amplitude of about 9.31 feet (although lagged in time by approximately 1.2 hours; see the District internet web site at //www.scvwd.dst.ca.us/floodmgmt/tidedesc.htm/). This constitutes an amplification of about 60 percent from the mouth of the bay to Alviso. Over an expected project life of 100 years, sea levels at Alviso could, therefore, possibly rise about 32 cm (approximately 1 foot). Storm surge and/or wind effects could potentially drive the tide stage even higher.

The twice-daily average tide prism in Alviso Slough (over the length of the slough) is equivalent to about a 3-year runoff peak flow (2,500 cfs twice a day). The tendency is for this to become the channel forming discharge, resulting in accretion or filling of the cross-section overbanks to a level that accommodates the required conveyance for the tidal prism. This provides ideal conditions for marsh vegetation establishment, which further constrains the ability to convey the larger, less frequent flood flows. This ongoing dynamic process occurs every day and, while providing significant habitat for endangered species, must also be recognized as a hydraulic constraint for future conditions (with or without a flood control project in place).

3.1.2 RIVERS

When the Guadalupe River projects (Upper, Downtown, and Lower) are completed, the present observable maximum capacity at UPRR will increase from 14,000 cfs to 20,000 cfs. This represents the 17,000 cfs contribution from the Downtown Project and up to an additional 3,000 cfs from local drainage pumped/discharged into the Lower Guadalupe River upstream of the Reconnaissance area. The present-day Alviso Slough lacks sufficient capacity to convey the design discharge of 20,000 cfs from UPRR to the bay. The carrying capacity of the channel depends on the corresponding tide. The existing conditions assessment indicates that Alviso Slough has a capacity of approximately 6,800 cfs at mean high tide. At bank-full flow near Alviso, a decrease of 1 foot in tide stage at the mouth of the slough translates approximately into an increase in capacity of about 1,000 cfs. Conversely, an increase in the tide stage results in a decrease in conveyance capacity. Because the system is constantly changing (tides, vegetation, marsh accretion, sedimentation, roughness, etc.), a dynamic analysis is most appropriate since allowances can be predictably prescribed for changing boundary conditions and/or other factors influencing capacity.

The Reconnaissance area has been subjected to both riverine and tidal flooding since the first dwellings were erected. Alviso and the surrounding area are on the fringe of the South Bay tidal marsh, and are situated in a historical co-mingled floodplain shared by both Guadalupe River and Coyote Creek to the east. (See Section 3.5 for more detail).

Recent historical flood events or serious threatening floods to Alviso and the Baylands area include:

December 1955:	Sometimes referred to as the "Christmas Storm", this flood event caused widespread flooding throughout the County. It is estimated that some 5,000 acres from Brokaw Road (near San Jose International Airport) to the Bay (SCVWD, 1997) were flooded.
April 1958:	Floodwaters overtopped the banks of the Guadalupe River, flooding about 2,700 acres of agricultural land and inundating the town of Alviso for 17 days (SCVWD, 1997).
1982:	Flooding of Alviso forced evacuation of the residents for about a week, inundating the town with as much as four feet of water. Damage to homes and businesses was estimated at about $4.5 million.
March 1983:	Flooding forced complete evacuation of the town for a period of several months. Flood depths reached 8 to 10 feet. Some 400 homes and/or businesses sustained an estimated $20 million in damages. Much of the contributing flood flows came from Coyote Creek, spreading out across the co-mingling floodplain, and passing through the town of Alviso to the bay.
March 1995:	Guadalupe River recorded its highest flow. Overbank flooding upstream limited the amount of flood flows reaching the Reconnaissance study area. Although Alviso was not flooded, flood fighting was required along the western margin of town next to Guadalupe River/Alviso Slough. Floodwaters did overtop into Cargill Salt ponds to the west. Anecdotal accounts placed the flood stage within two feet of overtopping into the town of Alviso (conversation, SCVWD: Ferguson, 1998).
February 1998:	High Guadalupe River flows in conjunction with a significant high tide again threatened the town of Alviso. Floodwaters did overtop the west levee across from Alviso and flooded into the Cargill Salt Ponds. Cargill constructed a temporary emergency levee to prevent additional overtopping into their ponds, but were required to dismantle it immediately thereafter to prevent induced flooding to the town of Alviso (conversation, Cargill:Douglass; SCVWD:Ferguson, 1998).

Over the last 80-100 years, Guadalupe River discharges have been confined to Alviso Slough. Discharges from the west side tributaries (San Tomas Acquino Creek, Calabazas Creek, Sunnyvale East and Sunnyvale West) have been confined to Guadalupe Slough. These sloughs have become significant linear environmental ecosystems supporting both floral and faunal habitat. Infrequent, significant riverine flood events not only pose a threat to people in the Reconnaissance Study area, but may also adversely impact these environmentally significant corridors and the designated refuges and wildlife areas adjacent to them.

3.2 PREVIOUS FLOOD CONTROL

3.2.1 PROJECTS

Projects to offset flood risk to the baylands area have been constructed by both public agencies and private businesses. These projects were constructed to protect against flooding from both watershed-derived flows (freshwater riverine) as well as tidal waters.

3.2.1.1 Alviso Levee

The town of Alviso has maintained a river access to the South Bay since the mid-1800's. Prior to the onset of subsidence, Alviso was above the tide stages and didn't require any levee/berm for protection. Increasing development within the Guadalupe River watershed further increased capacity requirements on the River and the need for flood protection to the town of Alviso. In the 1960s, a perimeter levee was therefore constructed around the west and northwest side of town.

3.2.1.2 UPRR-Marina Levee Project

Following the flooding of the early 1980's, the District improved the town of Alviso's constructed levee along Alviso Slough by raising its height, increasing the width to include a maintenance road, and relocating some buildings and utilities. This levee runs from the right bank of Guadalupe River at Gold Street bridge around the west side of town, terminating at the County Marina parking lot.

3.2.1.3 Salt Pond Levees

As much of the South Bay was being developed into salt manufacturing, levees were constructed to offset subsidence and reduce the threat of flooding from nearby sloughs and streams, as well as from the bay itself. These levees were generally not engineered, but do provide some limited degree of flood protection to the present-day salt ponds. These levees have continued to be built up with miscellaneous materials to offset continued subsidence, marsh accretion in the sloughs, and sea level rise.

3.2.1.4 Alviso Slough Ring Levee

As a result of the flooding to Alviso in the early 1980s from Coyote Creek overtopping, a temporary emergency ring levee was constructed to resist further Coyote Creek flooding until a flood control project could be designed and built on Coyote Creek. This emergency ring levee was subsequently replaced due to problems associated with materials used in the original construction. Once the Coyote Creek project was completed, the Alviso ring levee was dismantled under the presumption that Coyote Creek flood risk no longer existed.

3.2.1.5 Coyote Creek

The Coyote Creek Project was designed to provide up to 100-year level protection along the Lower Coyote Creek. The project extends approximately seven miles along Coyote Creek from the confluence of Coyote Slough upstream to Montegue Expressway. The two most downstream reaches, Reaches 1 and

2, overlap into the Reconnaissance Study area. Reach 1 improvements consist of main channel modifications as well as the construction of a bypass channel. Reach 2 consists of combinations of offset levees and overflow channels. Refer to the U.S. Army Corps of Engineers document, "Coyote and Berryessa Creeks, California, Coyote Creek, Final General Design Memorandum," (2 Volumes) for additional project information.

3.2.2 FLOOD FIGHT ACTIVITIES

Recent events in both March 1995 as well as January and February 1998 required flood fighting on the Guadalupe River - Alviso Slough at the County Marina. Both events did overtop the west levee across from Alviso into Cargill Ponds A8D, A8W, and possibly A7. In both events, sandbag levees were constructed in the County Marina parking lot area to prevent possible overtopping and subsequent flooding into the town of Alviso. Within hours of the February 1998 peak, Cargill constructed an emergency levee across the river from Alviso. Immediately after the flood threat had passed, Cargill removed the emergency levee and restored the low spot approximately to its previous level.

3.3 LAND SUBSIDENCE

Santa Clara Valley has experienced regional land subsidence since at least 1906 (Figures 3-2, 3-3). Much of this subsidence is attributed to large-scale groundwater withdrawals that occurred prior to 1965. In that year state water deliveries began to arrive in the San Jose area, reducing the demand for local groundwater. Subsidence and ground water table measurements taken near downtown San Jose from 1906 to 1995 reveal this trend (Figure 3-4), showing that almost all subsidence occurred between 1915 and 1965, to a depth of about 13 feet at this location. This is coincident with significant lowering of the groundwater table. Since then, the groundwater table has slowed its downward trend, and only about 1 to 1.5 feet of additional subsidence has occurred.

Figure 3-3 shows that land subsidence along the Guadalupe River has not been uniform, at least for the period 1934 to 1967 (Poland and Ireland, 1968). Subsidence was at a maximum in San Jose at 8 feet (1934 to 1967) and lessened with distance outward, approaching 3 feet at the mouth of the Alviso Slough. Subsidence in the Baylands area has been generally on the order of 3-6 feet during this time period, possibly greater over a more extended period. Land subsidence has altered the bed slope of the Alviso and Guadalupe Sloughs throughout their length. Subsidence of the baylands portions of the study area has also contributed to recent dramatic land encroachment of tidal processes extending up Guadalupe Slough, Alviso Slough, and Guadalupe River to about Montague Expressway.

Although the Water District in the Guadalupe River watershed has instituted significant groundwater recharge efforts, it is not definitive that subsidence has ceased, and in fact may still be ongoing at a rate similar to that prior to the early 1900's (see Figure 3-4).

3.4 MARSH ACCRETION

South San Francisco Bay (South Bay) has a very shallow bottom, with large mud flats exposed during low tides. During the long dry season, Alviso Slough the lower portions of Guadalupe River are subject to changing water surface elevations caused by the ebb and flood flows driven by Bay tides. Daily breezes during spring and summer create waves on South Bay that suspend clay and silt sediment. The suspended particles are transported with the tidal circulation into the contiguous sloughs, including Alviso Slough. Broad marsh areas once drained by the sloughs are now blocked by levees, reducing the upstream tidal prism and flow in the sloughs. The slow currents in the sloughs facilitate deposition of the suspended particles.

The Guadalupe River flows northward through San Jose, Santa Clara and Alviso, and discharges into the southern tip of San Francisco Bay through Alviso Slough. The banks are leveed along almost this entire reach. In 1963, the Santa Clara Valley Water District dredged an enlarged channel between the levees to an elevation of -10 feet (NGVD 1929) to provide adequate conveyance for storm runoff. Since then, sediment has deposited (accreted) in the slough onto the benched margins within the levees. Cross-section plots now show a narrow low-flow channel with a vegetated marsh on the bench margins between the edges of the low-flow channel and the levees. The result has been a reduction in overall hydraulic conveyance. In order to predict future changes to the marsh surface elevations within the existing cross-section, a two-dimensional sediment transport model was needed. Two-dimensional analyses by R.B. Krone & Associates (Krone, 1998) utilized an historical depth and the properties of eight (8) marsh cores (including the marsh elevations at the coring sites) to estimate the effective suspended sediment concentration, and to therefore predict long-term elevations on the benched marshes.

3.5 POTENTIAL REGIONAL FLOOD THREATS TO ALVISO

Preliminary system-wide analysis of the Baylands has identified multiple flood threats and sources of flooding to the town of Alviso. These possible sources include: (a) overtopping of Guadalupe River upstream (south) of town where floodwaters enter town along N. First Street; (b) overtopping of the County Marina parking lot at the northwest edge of town; (c) overflow from New Chicago Marsh fed by Coyote Creek to the north; and (d) excess floodwaters ponding in the low-lying area east of Alviso, Rincon de Los Esteros, which would drain off through Alviso (this could also be due to Coyote Creek overflow). The threat is, in essence, from all sides of Alviso.

Historically, the Guadalupe River would periodically overtop its banks and excess flow would inundate a natural floodplain corridor parallel to and east alongside the Guadalupe River. The present day floodplain, although rapidly becoming developed by commercial/industrial interests, is still a possible flood corridor passing directly through Alviso. This same corridor is still recognized by the District as the probable floodway for significant floodwaters exceeding the capacity of Guadalupe River (conversation, SCVWD:Reiller, 1998). Figure 3-5 displays the present floodway likely for these significant flood flows. Even with future Lower Guadalupe River Flood Protection Project improvements in place to increase the capacity to 20,000 cfs, any serious degradation or loss of conveyance capacity in the Lower Guadalupe River could resurrect the potential threat of overland flooding into Alviso along N. First Street.

3.6 ENVIRONMENTAL PROBLEMS AND OPPORTUNITIES

The potential effects of flood protection improvements on the following major categories of environmental issues will be used in the evaluation of alternatives. The criteria described in upcoming chapters and sections are preliminary and will be refined as alternatives and alternative concepts become better defined. In summary, the criteria are:

- Minimize the filling and removal of existing wetlands,
- Avoid or minimize disturbance to existing special status species habitat,
- Minimize disturbance to existing fish and fish habitat by restricting construction activities to months in which low flows occur (July-October) to avoid impacts to adult and juvenile salmonids,
- Avoid areas of hazardous materials and contaminated sediments,
- Avoid or minimize disturbing the existing cultural resources.

4 PLAN FORMULATION

4.1 OBJECTIVES

4.1.1 FLOOD CONTROL

As stated previously, the flood control objective of the Reconnaissance Study is:

- *Identify whether a flood risk exists to Alviso and the surrounding baylands area as a result of a) Guadalupe River, and b) other potential sources;*
- *Identify whether alternatives exist to reduce any flood risk identified in the study;*
- *If alternatives exist, develop them to a reconnaissance level (conceptual) only. Future planning and design activities will be required prior to final design, final environmental assessment and construction;*
- *Identify data needs to proceed to the next level of study.*

Therefore, this report documents both the existing and induced flood risk to the Reconnaissance area (primarily to Alviso and the nearby commercial salt pond operations), the formulation of potential solutions (at a reconnaissance level) to reduce that flood risk, and recommendations of the most likely possible alternative solutions.

It has also been recognized and agreed that quantifying the Guadalupe River associated impacts requires an understanding and consideration of other hydrologic inflow sources which contribute to the same hydraulic control as Guadalupe River and Alviso Slough. Although the primary focus of this study is to quantify the Guadalupe River contribution to possible flooding, the analysis must include the overall influence (from all sources) on Guadalupe River's flood potential. Results of sensitivity analyses have provided a more thorough understanding of the baylands area, and have confirmed this system-wide interdependence. More detailed investigations focused on the flood threats from these other sources to the Reconnaissance area might be addressed at a later date under a separate authorization.

4.1.2 ENVIRONMENT AND NATURAL RESOURCES

This study is a preliminary, reconnaissance analysis that prioritizes the development of alternatives that generally meet the area's flood control needs. The alternatives development process, however, must at least address both flood control and environmental issues. At this stage, environmental concerns were considered but no alternatives were eliminated based on environmental considerations.

The next step after this report will be to develop environmental screening criteria similar to those developed for the Lower Guadalupe River (LGRFPP) project. These criteria will then be used to assess project alternatives relative to the Project's environmental goals and constraints and screen out those that are not satisfactory. The "Environmental Performance" section in Chapter 5 suggests alternatives that may need to be discarded later because of environmental concerns.

4.2 STUDY CONSTRAINTS

4.2.1 FLOOD CONTROL

The following constraints to flood control analyses were considered for the reconnaissance-level evaluation:

Constraint	Meaning
◆ Utilize readily available existing data	In order to minimize costs, the study used mostly existing and readily available channel geometry, levee profiles, invert profiles, bridge data, previous hydraulic modeling geometry, and salt pond data collected over the past 30 years. Hydraulic boundary condition data ranged from 1970's through 1998 data where available, and tide stage data from the historical tide station at Dumbarton Bridge (longest tide data record in the immediate area).
◆ Build upon the results of previous analyses/studies	The results of previous analyses were taken and built upon by refining the models, using more suitable or revised programs, complimenting older data with newer, or using more precise data. Results will more reasonably represent present-day conditions.
◆ Incorporate terrestrial riverine hydraulics with tidal processes	The Recon area's interactivity between tide and riverine conditions was more accurately depicted by incorporating the dynamic (time series) variability of the riverine hydrograph and the cyclical tidal processes. This method more closely mimics the actual dynamic processes ongoing in the Recon area.
◆ Must be compatible with both the Downtown and the LGRFPP Projects	Continuity of hydraulic parameters is required to accurately depict the Recon area's response to LGRFPP and Downtown hydraulic performance and resulting delivery of flood flows to the Recon area. At the Guadalupe River hydraulic boundary to the Recon area (UPRR trestle), the discharge, flow regime, velocities, stage, etc. must be consistent from one project to the other.
◆ A long-term reduction in flood risk is the ultimate goal, not short-term temporary solutions	The District, Cities of San Jose, Milpitas, Santa Clara, the Town of Alviso, Cargill and U.S. Fish and Wildlife Service need solutions that will perform over an extended time horizon; not for the next 5-10 years only. Long-term planning, land use, environmental protection, and environmental restoration and/or enhancement need long-term hydraulic performance to be successful.
◆ Accommodate environmental concerns and/or impacts	With limited resources available to listed/threatened species and/or critical habitat, any impact needs to be identified and either avoided or mitigated when/wherever possible. Flood control solutions need to consider the possible impacts to these important species and their habitat.

4.2.2 ENVIRONMENT AND NATURAL RESOURCES

This study was a reconnaissance-level effort to describe environmental resources and impacts on these resources at a conceptual level. Data presented in this report are based on readily accessible existing sources. No new data were collected and no new surveys were conducted. As a result, the report is limited: the existing dataset is incomplete, and some data may also be outdated. For example, some parts of the Reconnaissance Study Area have never been surveyed for certain kinds of wildlife (e.g., mammals throughout the Reconnaissance Area, birds in most of the area's salt ponds, fish in the area's sloughs) or for key special-status species such as salt marsh harvest mouse and California clapper rail. Furthermore, many of the biological surveys used in this report were conducted more than 10 years ago (e.g., Carpelan 1957, H.T. Harvey & Associates 1989, 1990c).

In addition, recent cultural resources data in the Reconnaissance Study Area are very sparse, as in the past 10 years cultural resources surveys have been conducted only in Alviso and its immediate vicinity.

Readily available water-quality data are also lacking. Finally, maps and descriptions of existing land use in this report were based largely on the Alviso Master Plan (City of San Jose 1998a), discussions with City staff, and 1999 aerial photography. Given the rapid pace of development in north San Jose, land use data can quickly become outdated and further development may have occurred than what is known from these sources. Despite these limitations, however, some conclusions can be drawn regarding the potential environmental impacts and public acceptability of the selected alternatives.

4.3 FORMULATION CRITERIA

4.3.1 FLOOD CONTROL

Criteria	Purpose
◆ Protect Alviso from the design event on Guadalupe River (20,000 cfs).	As development has grown in the Guadalupe River watershed upstream of the Town of Alviso, runoff has increased. Alviso will be subject to flooding and risk to life and property from Guadalupe River until that flood threat is removed.
◆ Manage 20,000 cfs from UPRR to the bay.	Discharge events greater than current channel capacity of Alviso Slough (est. at ≅6,800 cfs ±) can cause damage to public and private properties.
◆ Use a 10-year tide as the downstream hydraulic boundary condition, to be consistent with other completed major projects.	The probability of a 10-year tide event at the same time as the design flood event on Guadalupe River is reasonable, and is consistent with District hydrologic/hydraulic criteria (Wang, pers.comm., 1999).
◆ Avoid/minimize destruction of existing environmental habitat (slough corridors; Triangle Marsh, NCM; A8D; etc.)	Because of diminished quantities of habitat in the South Bay, protection of remaining habitat contiguous to flood control features is a preferred expectation by District and the community.

4.3.2 ENVIRONMENT AND NATURAL RESOURCES

The potential effects of flood protection improvements on the following major categories of environmental issues will be used in the evaluation of alternatives. In general, alternatives or project components that have lesser effects on the resources or constraints described below will be judged to better meet the environmental evaluation criteria. The criteria described below are preliminary and will be refined as alternatives and alternative concepts become better defined.

- Minimize the filling and removal of existing wetlands. Wetlands are considered important environmental resources, and filling of wetlands is regulated by the federal Clean Water Act and discouraged by other federal and state laws. Alternatives that have fewer impacts on wetlands will generally be judged to better meet this evaluation criterion. During alternative refinement, the effects of alternatives on specific types of wetlands may need to be addressed.
- Avoid or minimize disturbance to existing special status species habitat, (e.g., tidal salt marsh habit, Cargill Pond A8D (dry portion), Triangle Marsh).
- Minimize disturbance to existing fish and fish habitat by restricting construction activities to months in which low flows occur (July-October) to avoid impacts to adult and juvenile salmonids. The lower Guadalupe River is primarily important as a passageway for anadromous fish moving up the river to spawn at higher elevations. However, rearing may also occur, particularly in deeper pool areas. In addition, other native and introduced fish species use this portion of the river. Alternatives that provide for preserved or improved fish habitat will generally be judged to better meet this evaluation criterion.

- Avoid/minimize the existing cultural resources. The Reconnaissance Study Area contains several known important sensitive archeological and historic sites and is likely to contain additional sites. Alternatives that minimize impacts on known important sites will generally be judged to better meet this evaluation criterion.
- Avoid areas of hazardous materials and contaminated sediments. Alternatives that minimize impacts on known sites and areas will generally be judged to better meet this evaluation criterion.

Alternative should be consistent with future goals to restore portions of the Cargill Salt Ponds to tidal wetlands as stated in the Baylands Ecosystem Habitat Goals (Goals Project. 1999).

4.4 BASELINE CONDITIONS

4.4.1 HYDROLOGY

4.4.1.1 Guadalupe River/Alviso Slough

Hydrology published by the U.S. Army Corps of Engineers (USCOE, 1977) includes storm frequencies and associated peak discharge rates shown in Table 4-1 in both metric (System International) units and English units.

These values represent discharges on the Guadalupe River downstream of Los Gatos Creek (near downtown San Jose) and are also prescribed by the Water District at Interstate 880. Figure 4-1 depicts the Corps' flow-frequency relationship, and also includes peak data collected at the downtown San Jose stream flow gaging station (USGS gage 11169000) during the period 1930 to 1995. The mean annual instantaneous peak discharge for the 1930 to 1997 period is approximately 3,479 cfs (98.53 m^3/s). It is worth noting that this mean *annual* peak discharge from the USGS gaging record is 1.5 times greater than the Corps' (published in 1977) *2-year* peak discharge of 2,300 cfs. Furthermore, the March 1995 record flood discharge of approximately 11,000 cfs (311.52 m^3/s) plots as a 70-year recurrence interval according to updated frequency analysis of the USGS data (through 1995), whereas a discharge of that same magnitude corresponds to only a 30-year recurrence interval when interpolated from the Corps'

Table 4-1. Downtown Guadalupe River Flow-Frequency Relationship

Event Frequency (USCOE, 1977)	Instantaneous Peak Discharge		Comment(s)
	(m^3/s)(A)	(cfs)(B)	
2-year	65.14	2,300	
5-year	127.44	4,500	
10-year	189.74	6,700	
25-year	283.20	10,000	
Approx. 30-year	294.50 - 311.52	10,400 - 11,000	10 March 1995 Storm Event
50-year	382.32	13,500	
100-year	481.39	17,000	Applies to single runoff condition in the Downtown Project(C)

(A) – units are cubic meters-per-second.
(B) – units are cubic feet-per-second.
(C) – assumes that Los Gatos Creek will peak at least six hours after Guadalupe River peaks, and flood storage is available in Lexington Reservoir. A Los Gatos Creek peak flow occurring earlier, or lack of storage upstream, could induce unanticipated flooding even though the peak discharge of the runoff event has not exceeded the project design flow for the Downtown Project (personal conversation, Dr. R.B. Krone). It is unknown what hydraulic impacts might occur in the Lower Guadalupe River and/or Reconnaissance study area as a result of this variation in lag time since no routing computations have been performed.

published hydrology (Figure 4-1). Other recent flood events of interest include 9,290 cfs (263.1 m^3/s) on 9 January 1995, 5,470 cfs (154.9 m^3/s) on 26 January 1997, and 7,512 cfs (212.7 m^3/s) on 3 February 1998.

The Santa Clara Valley Water District has specified the design discharges to be used for the present LGRFPP study. Within the upper part of the study, along Reach A adjacent to the San Jose Airport, the design discharge corresponds to the Corps' published 100-year (one percent) flood of 17,000 cfs (481.39 m^3/s). This is the same discharge used for the Corps' recent bypass project through downtown San Jose. The Water district has specified additional flows to be added incrementally downstream of Highway 101 up to a flow of 20,000 cfs (566.34 m^3/s) below Tasman Road, to account for storm water pump station inflows from CalTrans and the Cities of Santa Clara and San Jose. This represents the peak design flow rate entering the lower Guadalupe River Reconnaissance area (becoming Alviso Slough). For the LGRFPP as well as the Reconnaissance Study herein, pump station inflows below the USGS gage are assumed negligible (or at least non-coincident with the mainstem peak) for simulation of historic flood events. Figure 4-2 presents the Guadalupe River flow hydrographs used as input to the reconnaissance study hydraulic model for the design, March 1995, and February 1998 events.

4.4.1.2 Guadalupe Slough

Historically, the Guadalupe River continued westerly from the UPRR in Alviso toward the present Guadalupe Slough channel (see dashed line in Figure 4-3). The Guadalupe River now heads north then northwesterly at this location, becoming Alviso Slough. Although Guadalupe Slough has become cutoff from the Guadalupe River, it still carries significant flows due primarily to four tributary sources: San Tomas Acquino Creek, Calabazas Creek, East drainage from the City of Sunnyvale, and West drainage from the City of Sunnyvale. Santa Clara Valley Water District provided peak flowrates for the four tributaries for the March 1995 storm, February 1998 storm, and for the Reconnaissance Study design event. For the purposes of unsteady hydraulic modeling of the historic events, the design hydrographs were prorated (scaled down) to match the estimated peak flows at these four locations. Figures 4-4, 4-5, and 4-6 present the Guadalupe Slough tributary inflow hydrographs for the design, March 1995 and February 1998 events, respectively. The peak flows are summarized in Table 4.2. It is seen that while March 1995 was the record flood for the Guadalupe River, the February 1998 flood was considerably larger on the Guadalupe Slough inflows, nearly reaching the design event magnitude.

Table 4-2. Tributary Peak Inflows for Guadalupe Slough

	March 1995	February 1998	Design Event
San Tomas Aquino	6,875	8,718	9,100
Calabazas Creek	3,249	4,120	4,300
Sunnyvale East	831	1,054	1,100
Sunnyvale West	272	345	360

4.4.1.3 Coyote Creek

The Corps of Engineers final General Design Memorandum (GDM) for Coyote and Berryessa Creeks, prepared in 1993 by CH2M Hill, presents a 100-year hydrograph for Coyote Creek at Highway 237 with a peak discharge of 14,560 cfs. This was used as the design hydrograph in the analysis herein for the Reconnaissance area. Gaging records relevant to lower Coyote Creek (from Highway 237 downstream) are unavailable for historic events. The March 1995 and February 1998 event hydrographs on Coyote Creek were thus estimated by first determining the Guadalupe River scaling factors for these events to the Corps' 100-year event, then applying the same scaling factors to the Corps' 100-year hydrograph for

Coyote Creek. Figure 4-7 presents the resulting Coyote Creek flow hydrographs (used as input to the hydraulic model) for the design, March 1995 and February 1998 events. The resulting estimated peak flows for March 1995 and February 1998 are 9,421 cfs and 6,459 cfs, respectively.

Additional inflow to lower Coyote Creek comes from the WPCP Treatment Plant just northeast of Alviso. The plant discharges water into Artesian Slough, which in turn flows into Coyote Creek just upstream of the UPRR bridge crossing over Coyote Creek. Mean daily discharge during summer months is approximately 120 mgd (185.7 cfs); during the winter months it is about 160 mgd (247.6 cfs) (personal communication, R. Duke of H.T. Harvey).

4.4.2 HYDRAULICS

4.4.2.1 UNET Model Setup

The primary goal of the study as described in this report is to identify and analyze potential flood prone areas (i.e. - existing as well as induced flooding) within the Reconnaissance Study (baylands area), and to formulate possible alternatives that will help solve these flooding problems. The Reconnaissance area is hydraulically very complex, consisting of multiple freshwater inflow sources, backwater and flow reversals due to South Bay tidal cycles, interconnections from multiple storage areas (e.g. salt ponds or floodplain areas) combined with tributary branches and levee/berm overflows. Accordingly, a sophisticated numerical model is needed in order to achieve the goals of the study. The model should be capable of simulating unsteady flow so the joint occurrence of each inflow, the relative timing of the peaks, and the tidal exchange can be analyzed. The model should also be capable of handling a complex interconnected network of channels, overflows, and storage cells. The U.S. Army Corps of Engineers' UNET modeling software was chosen for this purpose (USCOE, 1997).

Figure 4-8 presents a schematic of the UNET model developed for the Reconnaissance study area. As shown in the schematic, the model consists of channel reaches for Guadalupe River/Alviso Slough (Reach 1), Guadalupe Slough (Reach 3), and Coyote Creek (Reaches 2, 4 and 5), with their corresponding specified inflow boundary conditions (as described in the previous section). The model extends downstream to within 1 mile of the Dumbarton bridge, which is a purely tidal boundary condition. The channel reaches are geometrically represented in the UNET model by cross-sections, similar to an HEC-2 or HEC-RAS model. The cross-sections for Guadalupe River/Alviso Slough were taken from the baseline HEC-RAS model from the LGRFPP study. These cross-section data originate from 1996 Santa Clara Valley Water District surveys and mapping. Cross-sections on Guadalupe Slough were taken from an HEC-2 model also developed by the Water District. For Coyote Creek, cross-sections were estimated from USGS quadrangle maps. All cross-sections in the model are oriented facing in a downstream direction and are also placed in an upstream to downstream order (downwater as opposed to backwater); this is standard UNET format. Elevations are with respect to the NAVD 1988 datum, in English units (UNET does not accommodate metric units). All input cross-section data used in the UNET model were therefore modified accordingly.

In addition to channel reaches (which simulate conveyance and storage in UNET), storage-only cells were also created to represent isolated ponding areas. These are shown in Figures 4-8 and 4-9 as the Cargill salt evaporation ponds (with their pond designation) and floodplain or marsh areas in the Alviso area (town of Alviso, New Chicago Marsh, and the Rincon de Los Esteros area). The ponds are interconnected by weir input cards that describe the top of berm elevation profiles between the ponds. Low portions of the levees along the channel reaches are also input as weirs, with connections to the appropriate storage cells. The bottom elevations and surface area data for the cells were estimated from topographic maps provided by Cargill. The weir elevations were also estimated from these maps as well as from limited survey data along the levees. Because the extent of available topographic data in some of these areas (also Coyote Creek cross-sections) is quite limited or sporadic, approximations or estimations sometimes had to be made. The resulting UNET model is fully sufficient for a reconnaissance level study such as this, but would require further refinement for more detailed studies.

4.4.2.2 South San Francisco Bay Tides

Recent continuous measurements of tide levels are very limited in the southern part of San Francisco Bay. The Alviso Slough - Coyote Creek confluence is listed as an NOAA tidal station, but recent data (1995 to present) do not appear to be available. Measured tidal data is intermittently available at the Dumbarton bridge, but not coincident with all the floods of interest in this study (March 1995 and January/February 1998). Therefore, tidal data for the downstream boundary condition of the UNET model were either generated using the Tides and Currents program (Nautical Software Inc., 1997), which adjusts measured tides from the NOAA tidal station at Presidio (San Francisco), or by manual adjustment of Presidio data using shifts and scaling factors provided by the NOAA. Either method results in similar tide predictions. For the purposes of the reconnaissance study this is sufficient, although this method typically does not accurately estimate the effects of storm surges to the adjusted tides.

For the March 1995 flood, the corresponding estimated tide was at or near "neap" condition (see Figure 4-10). Tidal conditions would have been more than 1 ft higher if the flood coincided with high tide. For design studies with tidal influence, it is acceptable (conversation, SCVWD:Wang, 1999) to assume a 10-year tide coincident with 100-year flows. For simulation of the design event in this study, the March 1995 tide was amplified to match the Corps of Engineers published 10-year tide for this area of the south Bay.

4.4.2.3 March 1995 Event

The UNET model was initially run under the March 1995 boundary conditions (inflows and tide). Manning's n values for Guadalupe River and Alviso Slough were chosen to match those from the calibrated baseline HEC-RAS model from the LGRFPP study. In the UNET model, this resulted in slight under-prediction of measured water levels at some locations on Guadalupe River (upstream of the Reconnaissance Study area). It is not unusual, for a given n value resistance, that an unsteady model will produce somewhat lower water levels than a steady-state model. In order to produce a better fit to the measured data, channel conveyance was slightly decreased in the model over two small sub-reaches upstream of UPRR. In UNET, this can be done without changing the n values.

Within the Reconnaissance area measured high water data appears to be unavailable, including measured tides. Even anecdotal information on historic floods is limited, although personal communication with the Water District, Cargill, and observation of air photos suggests the Cargill ponds between Alviso and Guadalupe Sloughs (A5 to A8, so-called "Knapp Ponds") were inundated. This was primarily due to overflows along a low section of the Alviso Slough west bank levee into pond A8W, across from the town of Alviso, but also some possible overflow further downstream into pond A7. New Chicago Marsh to the north of Alviso was also flooded due to Coyote Creek overflows into the New Chicago Marsh Canal. These overflows were via an inline weir at the north end of the canal, which has been approximated in the UNET model. The town of Alviso remained essentially dry.

Model results replicate the anecdotal flooding information in the Reconnaissance area reasonably well. Figure 4-11 presents a map of the Reconnaissance area, with the March 1995 overtopping locations noted along with the resulting depths of water in the adjacent storage cells. As shown, west bank levee overtopping along Alviso Slough flooded Cargill salt ponds A8W and A7, which in turn overtopped the berms into A8D and A5. According to the model, pond A8W flooded the greatest – to a depth of 5.4 ft. New Chicago Marsh was also shown to flood, due to overtopping from Coyote Creek (and did not overtop into either Alviso or the Rincon de Los Esteros). As mentioned previously, however, Coyote Creek inflows were not gaged but were estimated by applying prorated Guadalupe River peak discharges to the Coyote design hydrograph. Thus, conclusions due to Coyote Creek overtopping should be made cautiously.

4.4.2.4 February 1998 Event

The flood event in early February 1998 was very significant on Guadalupe Slough, nearly reaching design event magnitude. On Guadalupe River (Alviso Slough) it was a more modest event, about a 10-year to 15-year recurrence interval. Measured and/or anecdotal information of flood depths and overtopping locations is also limited for this event. Other than boundary conditions, no further adjustments were made to the model from the March 1995 simulation (e.g. Manning's n values, specified potential overtopping locations, etc.).

The map in Figure 4-12 shows overtopping of Guadalupe Slough only at one location, into A8D and reaching a pond depth of about 1 ft. Pond A8D reached an estimated depth of 3 ft during the March 1995 simulation, but this was due to overflow from pond A8W and not from Guadalupe Slough. Overtopping from Alviso Slough into pond A8W occurred again in February 1998, but to a much lesser extent than March 1995 – reaching an average flood depth of only 0.4 ft in A8W. Flooding of New Chicago Marsh was slightly less than modeled for March 1995, due to scaled down estimated inflows on Coyote Creek.

4.4.2.5 Design Event

After testing the model for the recent historic flood events, simulations were then performed under two design event scenarios. The first assumes present day existing conditions, with a peak inflow to Alviso Slough of only 14,000 cfs. The approximate capacity of the existing levees upstream on Guadalupe River is about 14,000 cfs. Under existing conditions it is estimated that only this amount would reach Alviso Slough, as during the design flow peak of 20,000 cfs the remaining amount would overtop the Guadalupe River levees. The 6,000 cfs that overtopped out of Lower Guadalupe River was assumed to flow northward along North First Street to Alviso. It was assumed that one-third of the overtopping floodwaters would remain in local storage along North First Street, and that two-thirds would continue north of Highway 237 into Rincon De Los Esteros and Alviso. This scenario also presumed 100-year events on the contiguous watersheds of Coyote Creek, and the Guadalupe Slough tributaries. This assumption is based on the premise that the storm front initiating a 100-year event on the Guadalupe River watershed is of a regional dimension (i.e. - not a cloudburst or localized event) affecting the entire northern California region, not just one specific watershed.

The second scenario assumes the full 20,000 cfs peak hydrograph inflow to Alviso Slough. This represents future flood control improvements on the lower and downtown reaches of the Guadalupe River that will contain the design event. Full design inflows on Guadalupe Slough and Coyote Creek were used for the future conditions design event scenario. This assumes coincident 100-year storms on all three streams, which may correspond to a somewhat larger joint recurrence interval. This is reasonable for a reconnaissance level study. An estimated 10-year tidal cycle was used as the downstream boundary condition for both simulated design event scenarios. And, the occurrence of the Coyote Creek watershed peak was lagged eleven hours after that of the Guadalupe River peak flowrate..

Figures 4-13 and 4-14 present the results of the existing "today" design conditions (14,000 cfs Alviso Slough inflow and 6,000 cfs N. First Street flooding) and future design conditions (20,000 cfs Alviso Slough inflow), respectively. Comparison of these two figures shows considerable flooding of the Cargill ponds A5 through A8 under both scenarios, with flood depths under the future design scenario on the order of 5 ft greater than for the existing present-day scenario. The berms separating these ponds are completely submerged by several feet under the future scenario, resulting in one large continuous level pool. During the receding end of the flood, water from pond A5 reverses flow to drain back into Guadalupe Slough. Under the future design flow scenario, flows also eventually overtop the left (south) bank levee of Guadalupe Slough into the A3E salt pond, although only reaching an average depth of 0.2 ft in the pond. The USFWS Refuge (formerly Pond A6) is not impacted under existing conditions (14k cfs in Alviso Sl.) but is inundated by the future design (20k cfs in Alviso Sl.) scenario.

The results, in terms of depth of flooding, of all the baseline UNET runs (March 1995, February 1998, design event scenarios) are summarized on the next page in Table 4-3, to the nearest tenth of foot. In addition to flooding of storage areas A5, A7, A8W, and A8D, the Cargill ponds just west of the New Chicago Marsh Canal (A13 and A15) are also subject to flooding under each of the simulated events, as indicated in the table. Under the March 1995 and February 1998 flood conditions, the level of flooding is only a nominal amount (less than 3 inches). Flood depths increase under design event flow conditions, with some additional overflow to pond A12.

As shown in Table 4-3, an additional model run was also made (under present-day design conditions – 14,000 cfs) to determine the effects of preventing the overflows from Alviso Slough into Cargill pond A8W (and A8D). The overflow into A8W acts like a pressure release valve on Alviso Slough. Eliminating this release of flow (i.e. raising the low part of the levee) would cause right (east) bank overtopping downstream at the Marina and into the town of Alviso and into Cargill pond A12. Flood depths in both Alviso and A12 would reach an average depth of about 0.7 ft. With the A8W "pressure release valve" functioning as present, but assuming the future design scenario (of 20,000 cfs), flood depths would still reach a similar level in Alviso. Under this future condition, Alviso is vulnerable to flooding from three sides: overflows at the Marina as well as Coyote Creek overflows from both New Chicago Marsh and Rincon de Los Esteros. Improving the Lower Guadalupe River capacity to manage 20,000 cfs in-channel would eliminate the Alviso flooding contributed by overtopping Lower Guadalupe River floodwaters entering Alviso along the North First Street corridor. Eliminating the Alviso Slough overtopping into Cargill Pond A8W (by building up a levee or floodwall on the west Alviso Sl. Levee would increase flooding into Alviso through the County Marina.

Table 4-3. Baseline Comparison Of Maximum Water Depths (Ft)

SITE	*1995 (11,000 cfs)*	*1998 (7,500 cfs)*	*Existing Present-day(1) (13,000 cfs)*	*Existing Present-day(2) (13,000 cfs)*	*Future Design (20,000 cfs)*
Alviso				0.7	0.6
NCM Canal	7.1	7.1	7.2	7.2	7.2
New Chicago Marsh	3.1	2.9	3.6	3.6	3.9
Rincon De Los Esteros					0.1
A3E			Nominal	Nominal	0.2
A3W					
A5	0.2		3.5	2.0	8.5
A7	2.6		3.5	3.0	8.7
A8D	3.0	1.1	3.5	0.6	8.8
A8W	5.4	0.4	5.9	0.6	11.1
A11					
A12				0.7	0.6
A13	0.2	0.2	0.6	0.6	1.6
A15	0.2	0.2	0.5	0.5	1.1
A16					
A17					

(1) 13,000 cfs at UPRR from estimate of present day LGR channel capacity, with 10-year tide in Bay.

(2) 13,000 cfs at UPRR from estimate of present day LGR channel capacity, with 10-year tide in Bay, without opportunity to spill into Cargill Ponds A8.

Pond A6 (Refuge) gets inundated under the "Future Design" condition (20,000 cfs), however data is lacking in order to estimate a reasonable depth.

4.4.3 GEOMORPHOLOGY

In the Reconnaissance Study Area, topography is relatively flat, with elevations ranging from near sea level at the Bay margin to 15 feet above mean sea level in the southeastern portion. Extensive pumping of groundwater for agricultural and urban uses has resulted in area-wide subsidence. Between 1934 and

1967, subsidence in Alviso may have been as much as six feet, resulting in portions of Alviso now as much as 1 foot below mean sea level and portions of New Chicago Marsh are as much as 3 feet below sea level.

The tidal marsh sloughs exist today as confined floodways for Guadalupe River, San Tomas Acquino Creek, Calabazas Creek, and the Sunnyvale drainages. The natural meandering sloughs have been straightened and/or confined by levees, giving them a relatively constricted cross-sectional geometry that is narrower and deeper than in the original sloughs. Historical changes to the tidal marsh planform and slough cross-sections are detailed below.

4.4.3.1 Changes in the Marsh Planform

Downstream of Alviso, channel patterns have changed dramatically from their original alignment. At the turn of the century, the tidal zone downstream of Alviso was characterized by a complex distributary channel flow pattern, with the number of flow channels increasing downstream. Figure 2-2 reveals that the baylands planform has been modified significantly as a result of commercial salt generation, resulting in the creation of large, shallow evaporation basins in place of the numerous channels and tidal marshland.

Presently, levees confine flood flows to narrow channels within the two remaining sloughs (Alviso and Guadalupe) from generally the southern limit of the Reconnaissance area north and westward to South San Francisco Bay. These same levees also confine the twice-daily tidal prism that floods into and out of the sloughs. All of the levees surrounding the salt ponds are non-engineered structures, consisting of materials that have been (and continue to be under maintenance activities) dredged from the salt pond areas and placed along the present levee alignments.

4.4.3.2 Changes in Slough Cross-Section

A previous hydraulic sensitivity assessment of Alviso Slough found that Alviso slough is gradually changing its cross-section configuration to a narrower, steeper sided shape as a result of the twice-daily tidal processes (i.e. - a combination of tidal hydraulic capacity and marsh accretion). Large flood flows due to infrequent hydrologic events do not affect the long-term cross-sectional channel shape. Rather, the slough's requirement to convey the twice-daily tidal prism dictates the cross-section configuration. Comparisons of surveyed cross-sections at representative locations along Alviso Slough, taken in November 1995 (SCVWD) and in July 1998 (Cargill), are shown in Figures 4-15 and 4-16. The section plots show a consistent tendency for the sloughs to accrete (or build) the marsh plain along the interior benches between levees, and also a tendency to steepen the banklines. The channel conveyance area is reaching an equilibrium to handle the twice-daily tidal prism (an average over the entire length of the slough of approximately 2,500 cfs, and equivalent to about a 3-year event on the Guadalupe River), at the expense of much needed cross-sectional area for the infrequent larger Guadalupe River floods. The tendency is for the channel to transform from a traditional trapezoidal flood control configuration to that of a traditional tidal marsh slough.

Over the water year period 1930 to 1998, the Guadalupe River monthly mean flow rate to Alviso Slough varies from between 3 and 163 cfs (USGS, 1999); or up to about 5 percent of the twice-daily tidal prism acting on Alviso Slough. The maximum monthly flow rate for the same period on Guadalupe River is only from 22 to 1,165 cfs, or about 45 percent of the twice-daily tidal prism. The tidal processes having a greater effect to stimulate changes in the slough geometry and capacity. Although cross-sections for comparison on Guadalupe and Artesian Sloughs were not available at the time of this study, the exact processes impact these sloughs as well, resulting in a decrease in capacity to that which is necessary to manage the twice-daily tidal prism.

4.4.4 GEOMETRY

The geometry used in the hydraulic analysis is predominantly from District, and supplemented by more recent surveys and topographic data collection performed by the District and others.

The most recent comprehensive data is that depicting Alviso Slough. District used both ground surveys and orthophotographs in 1995/1996 to produce a HEC-2 model for hydraulic analyses. Cross-sections were ground surveyed approximately every 90 meters, and 30-meter intermediate cross-sections were synthesized from the orthophoto contours. Cargill performed Alviso Slough verification surveying in 1998 which included profiles of both the left and right levees, and six cross-sections taken at various locations where District collected sections in 1995/1996. These data were used to formulate the UNET model geometry for the Alviso Slough component of the Baylands system model used in this Reconnaissance Study.

Guadalupe Slough geometry used in the UNET modeling is from 1981 District HEC-2 models. Ground and hydrographic surveying of Guadalupe Slough was performed in the 1970's by the District for use in hydraulic analysis. Unfortunately, no more recent comprehensive data collection has been done since, even though moderate channel dredging, levee maintenance, and marsh accretion inside the levees has occurred between 1970's and the present. Some sporadic, localized surveying has been done along Guadalupe Slough (for other projects/purposes) and this data has been used where possible to improve the Reconnaissance Study system model. The District has collected a nominal amount of data in 1995 and 1998. Cargill (and formerly Leslie Salt) has been collecting spot data along the slough over the past 20 years, but no comprehensive data have been collected. Channel invert, levee profiles, and accretion of overbank areas between the low-flow channel and the levees in the current dataset are antiquated, and may no longer necessarily be representative of the present-day Guadalupe Slough. These data, now 20+ years old, have not been corrected for subsidence, maintenance practices, accretion and/or significant vegetation growth in and along the slough.

A short portion of San Tomas Acquino Creek that borders Cargill pond A8D is depicted in the UNET system model. The channel geometry for this component is based on 1980's District HEC-2 data. 1998 survey data collected by Cargill was used in the UNET model to represent the levee overtopping location between San Tomas Acquino Creek and Pond A8D.

The UNET geometry used to represent the Cargill salt ponds is primarily from Cargill data collected between 1981 through 1999. Much of the data is point or spot data, ranging in 0.5-1.0 mile intervals. These data were used to depict pond inverts, pond separation berms, and perimeter bay-front levees holding back Coyote Creek, Guadalupe and Alviso Sloughs.

A flow control structure located between New Chicago Marsh and Coyote Creek, which controls inflows to New Chicago Marsh, is included in the UNET system model. However, the present physical characteristics (size, elevation, etc.) is based solely on field observations, and not on surveyed topographic data. This feature may play an important role in identifying and quantifying a Coyote Creek flood risk to New Chicago Marsh and Alviso, and thus will require specific data collection to substantiate its role in present and future Alviso flood risks.

Alviso and surrounding developable areas to the east are also depicted in the UNET system model. The topographic data representing these areas is predominantly from USGS mapping, and a few, sporadic or spot surveys collected by District in 1998. Any recently adopted or proposed land use development plans to build pads or change the topography have not been included in the current UNET system model. Although Alviso is represented in the UNET model by a single invert elevation, in reality there is a 1 to 3 foot range of lower ground elevations throughout town. Thus, a modeling prediction of a single depth of inundation could be interpreted as a minimum depth, understanding that the actual depth of flooding could be 1 to 3 feet more than predicted. Additional surveying in future studies could be used to refine or improve the estimation of flood risk.

4.4.5 ENVIRONMENT AND NATURAL RESOURCES

Due to a wide variation of the age and quality of available environmental data, the reliability of the baseline conditions used in the environmental analysis for this study varies accordingly. A more detailed discussion on this topic is provided as Appendix A. Table 4-4 summarizes the approximate dates of the environmental baseline data used in the environmental analysis.

Table 4-4. Approximate Date of Baseline Conditions Data Used in Environmental Analysis

Environmental Topic or Subtopic	Approx. Baseline Date	Notes
Physical Parameters		
Topography	2000	Date applies only to general description, not to topographic data required for hydrologic modeling.
Soils	1968	
Geology	1998	
Land Use	1998	Data on some sites updated based on 1999 aerial photography and Aspot@ site visits in early 2000.
Socioeconomics	1990	Data from 1990 United States census.
Air Quality	1999	
Water Quality	n/a	Data very limited; data for some pollutants as recent as 1998.
Vegetation		
Sloughs, ponds, creeks	1999	Based on interpretation of infrared satellite photos.
Uplands, Rincon de los Esteros	1998	
Wildlife		
Mammals	n/a	Surveys for salt marsh harvest mouse conducted in some areas between 1974 and 1990.
Birds	highly variable	Bird use in sloughs, creeks, and rivers was well documented in 1997; data on salt ponds are less complete.
Fish	1989	
Reptiles and amphibians	n/a	Very few survey data are available.
Other wildlife	1989	Report relied on extensive existing surveys of invertebrates in salt ponds (Lonzarich 1989); invertebrate data in sloughs and other open water not consulted for this report.
Cultural Resources	n/a	Few recent surveys have been conducted; surveys were conducted only in Alviso and its immediate vicinity.
Recreation	1998	

4.5 ALTERNATIVES DEVELOPMENT

4.5.1 PRELIMINARY SENSITIVITY UNET MODELING

In order to better define the areas and extent of flood risk under varying boundary condition assumptions (inflows and tides) and the potential impacts to certain areas such as Alviso due to hypothetical protection of other areas (by raising levees for example), a series of preliminary UNET simulations were performed. These model runs help us to define how sensitive these areas might be to improvements within the system and upstream, and allow us to better formulate effective alternatives.
In general, the sensitivity runs looked at combinations of the following "what-if" situations:

- Various inflows (March 1995, Present-day & Future Design, lagged Coyote inflow, low baseflow, etc.)
- 10-year and 100-year estimated tides,
- Preventing overflows toward Alviso (i.e. from Alviso Slough or Coyote Creek into NCM Canal)
- Protecting Cargill ponds A5 to A8 from Alviso Slough and/or Guadalupe Slough overtopping

The scenarios modeled as part of the UNET sensitivity analysis are presented in Table 4-5. Results of the modeling, in terms of average flood depths within model storage areas (i.e. Cargill salt ponds and floodplain cells), are presented in Table 4-6 for each of the 20 sensitivity runs.

Table 4-5. UNET Sensitivity Analysis - Modeling Scenarios

Scenario No.	Study Area Conditions:
1.	20000 cfs (future design) Alviso Slough with all overflow into Alviso disabled
2.	20000 cfs without A8D ponding (i.e. no overflows into A8D)
3.	20000 cfs without A8D ponding and all overflow into Alviso disabled
4.	20000 cfs without A8W overtopping from Alviso Slough
5.	13000 cfs Alviso Slough inflow with no Coyote Creek overflow (into NCM Canal)
6.	11000 cfs Alviso Slough inflow with 10-yr tide
7.	11000 cfs with 10-yr tide and without overtopping to pond A8W
8.	10-yr tide with 50 cfs inflow on all tributaries
9.	10-yr tide with 50 cfs inflow on all tribs and without A8W overtopping
10.	100-yr tide with 50 cfs inflow on all tribs
11.	100-yr tide with 50 cfs inflow on all tribs and without A8W overtopping
12.	20000 cfs Alviso Slough inflow with Coyote Creek hydrograph lagged 12 hours
13.	20000 cfs without Coyote Creek overflow
14.	20000 cfs without Coyote Creek overflow and without A8W overtopping
15.	17000 cfs Alviso Slough (future design inflow but without LGR pumps operating)
16.	17000 cfs without A8W overtopping from Alviso Slough
17.	20000 cfs Alviso Slough without Guadalupe Slough overtopping into ponds A5-A8
18.	20000 cfs without Guadalupe Slough A5-A8 overtopping and without Coyote Creek overflow
19.	20000 cfs without Guadalupe Slough A5-A8 overtopping and without Coyote Creek overflow and no A8W overtopping
20.	17000 cfs Alviso Slough without A5, A8D, and NCM Canal overtopping

Table 4-6. Sensitivity Analysis Comparison of Maximum Water Depths by Scenario (ft, nearest tenth)

SITE	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*
Alviso		0.6		4.4								0.5	0.3	4.4		3.8	0.7	0.3	4.4	
NCM Canal	7.2	7.2	7.2	7.5		7.1	7.1	4.6	4.6	5.3	5.3	7.2		5.8	7.2	7.2	7.2		5.8	
NCM	4.0	3.9	4.0	4.7		3.3	3.3	0.1	0.1	0.2	0.2	4.0		3.1	3.8	4.0	3.9		3.1	
Rincon de los Esteros	0.2	0.1	0.2	1.2								0.1		1.1		0.5	0.1		1.1	
A3E	0.2	0.3	0.3	0.2	Nom.							0.1	0.2	0.2	Nom.	Nom.	0.5	0.5	0.5	0.1
A3W																	0.1	0.1	0.1	
A5	8.5	8.7	8.7	3.7	3.5	0.2	Nom.					8.4	8.5	3.8	6.8	3.3	9.0	9.1	3.5	6.7
A7	8.7	8.9	8.9	3.8	3.5	2.6	2.6					8.6	8.7	3.8	6.9	3.3	9.1	9.1	3.5	6.7
A8D	8.8			3.7	3.5	3.0	Nom.					8.7	8.8	3.7	6.8	1.6	9.1	9.1	3.1	6.7
A8W	11.1	11.4	11.4	6.0	5.9	5.4	0.1					11.0	11.2	6.1	9.2	4	11.4	11.5	5.4	9.0
A11				3.3										2.4					2.4	
A12	0.6	0.6	0.6	3.9			Nom.					0.4	0.5	3.3	0.1	2.4	0.6	0.5	3.3	0.1
A13	1.6	1.6	1.6	4.3		0.2	0.3					1.6		3.7	0.9	2.8	1.6		3.7	
A15	1.1	1.1	1.1	1.7		0.2	0.2					1.1		0.1	0.8	0.8	1.1		0.1	
A16																				
A17																				

NOTE: Nom. means "nominal", and refers to flood depths less than 0.05 ft
Pond A6 likely gets wet under scenarios 1-3, 12, 13, 15-18, & 20; however, lack of site data precludes the ability to estimate depths.

General conclusions resulting from the sensitivity analysis UNET modeling are itemized below. The remainder of Section 4.5.1 then presents a more thorough discussion of the sensitivity modeling, which led to these conclusions:

- Preventing overflows into Cargill ponds A5-A8 from Alviso Slough during the future design event (i.e. combined with upstream flood control improvements) will result in extensive flooding in the town of Alviso, up to about 4.4 ft;
- Overflows from Coyote Creek (which contribute to flooding in Alviso and Rincon de Los Esteros) can be blocked without significantly impacting other areas of the baylands study. A ring-levee completely surrounding Alviso would also not likely cause significant impacts elsewhere;
- Reducing the future design flow from 20,000 cfs to 17,000 cfs, which would assume local pumped inflows upstream of the Reconnaissance area could be eliminated, would reduce flooding in Alviso from Guadalupe River/Alviso Slough, but would create flooding to Alviso from the 3,000 cfs pouring into the North First Street corridor.
- Eliminating overtopping to A8W from a 20,000 cfs Guadalupe River event would flood Alviso to an estimated depth of about 3.8 ft (through the County Marina);
- Under future design flow conditions, it is counter-productive to raise the Guadalupe Slough right bank levee (along pond A5) without also raising the levee from Alviso Slough into A8W, because the Guadalupe Slough levee provides an outlet for Alviso Slough overflows reaching pond A5.

The first four runs (listed in Table 4-5) all assume future design flow conditions (20,000 cfs Alviso Slough inflow). One option for protecting Alviso would be a ring-levee, or another method of blocking overflows at the Marina and at Coyote Creek. Compared to the baseline future design event (Table 4-3), the results in Table 4-6 (either Run 1 or 3) indicate that such action would not have a significant impact elsewhere in the Reconnaissance system. The Rincon de Los Esteros area would show a slight increase in flood depth (0.1 ft) under this scenario, unless the Coyote Creek overflows were blocked "at the source," thus protecting Rincon de Los Esteros as well. It appears from Run 2 that pond A8D, in which endangered Snowy Plover birds nest, could also be protected from overflows with impacts of only 0.1 to 0.3 ft (a few inches) elsewhere in ponds A3 to A8. Run 4 illustrates that if future Guadalupe River upstream flood control improvements were combined with raising the levee into pond A8W, there would be extensive flooding in the town of Alviso, with an estimated flood depth of about 4.4 ft, and additional flooding to Rincon de Los Esteros. Either of these actions alone would flood Alviso to a depth of 0.6 to 0.7 ft (as discussed previously in the baseline modeling), but when combined the flood risk to Alviso is much greater. The Knapp Ponds A5 to A8 would still flood under the Run 4 scenario, but flood depths would decrease by about 5 ft.

Preventing overflows from Coyote Creek into the New Chicago Marsh Canal in order to reduce or minimize flooding in Alviso and surrounding areas will not significantly affect flooding in other parts of the Reconnaissance area (such as Cargill ponds A5-A8), under either design flow condition (Runs 5 and 13). Under the future design condition (20,000 cfs Alviso Slough inflow), the town of Alviso and pond A12 will still flood due to Alviso Slough overtopping, but it would be to a lesser extent with Coyote overflows prevented.

Run 6 suggests that if the March 1995 event were to coincide with a 10-year tide, which is on the order of 2 ft higher than the actual assumed tide for that event, flood levels within the Reconnaissance area ponds would not change significantly. Preventing overflows into A8W under these same boundary conditions (Run 7) would reduce the depths of flooding in ponds A5–A8 without impacting Alviso. Although some flooding within A5-A8 would still occur due to overtopping further downstream into A7. Flood risk due to high tides alone (with insignificant upstream inflows) was analyzed in Runs 8 through 11. A more thorough investigation of the tide flood risk is suggested since these analyses are based only on sparse existing, readily available geometry and data.

Runs 12 through 14 investigate varying Coyote Creek conditions under the Alviso Slough future design inflow of 20,000 cfs (assuming upstream flood control improvements on Guadalupe River). Compared to the baseline, Run 12 indicates that lagging the Coyote Creek inflow hydrograph by 12 hours would not significantly change flood levels anywhere in the Reconnaissance Study area (more than about 0.1 ft). This suggests that the extent of overflow from Coyote Creek into New Chicago Marsh canal is largely independent of downstream flood conditions (from Alviso Slough or Guadalupe Slough). Which further suggests that the assumed coincidence of Coyote flood peak may be less relevant. Run 14 illustrates that even if Coyote Creek overtopping is blocked, Alviso will still flood to about the same level of 4.4 ft when overflows from Alviso Slough into pond A8W (future design flow) are blocked. Reducing the future design flow to 17,000 cfs, which assumes local pumped upstream inflows can be eliminated, would reduce Alviso from Guadalupe River flooding (Run 15). Unfortunately, the 3,000 cfs flows not reaching Alviso Slough from Guadalupe River are likely to flow down N. First Street eventually flooding Alviso. If overtopping to A8W was again prevented, Alviso would still flood significantly to an estimated depth of about 3.8 ft (Run 16) from Guadalupe River.

The remaining runs, 17 through 20, investigated the varying effects of protecting Cargill ponds A5-A8 (the Knapp ponds) from Guadalupe Slough. It can be concluded from these runs that, under future design flow conditions, it is counter-productive to raise the Guadalupe Slough right bank levee (along pond A5) without also raising the levee from Alviso Slough into A8W. The reason is that Alviso Slough overflows going into A8W eventually reach pond A5 and flow out of A5 and into Guadalupe Slough. Raising the A5 levee would prevent this outflow and actually result in increased flood depths (see Run 17, compared to baseline). However, if we eliminate both the A8W and the A5 overtopping, then ponds A5-A8 only flood due to Alviso Slough overtopping directly into pond A7. This reduces flooding of these ponds by about 4 or 5 feet to flood depths of only 0.3 to 0.7 feet (Run 19). It must be stressed again, however, that any elimination of A8W overflows under future conditions causes significant flooding to Alviso, on the order of 4 feet, and also increases flooding to Cargill ponds A11-A13.

4.5.2 PROBLEM AREAS

The largest potential problem area, which affects the largest number of inhabitants, is the town of Alviso. Any significant steps taken to protect Cargill salt ponds A5 to A8 may have significant impacts on Alviso. Future flood control improvements upstream on Guadalupe River will also likely impact flood levels in Alviso, unless corrective action is otherwise taken. Furthermore, Alviso is susceptible to "backdoor" flooding from Coyote Creek, as are developments within the adjacent Rincon de Los Esteros area (although to a lesser extent since ground elevations are generally higher there).

Cargill's salt evaporation ponds are also at risk to flooding and are likely to flood more frequently than Alviso. Significant overtopping of the levee into A8W will begin at events of comparable magnitude to February 1998 (7,500 cfs). Under future design event conditions, 20,000 cfs (i.e. with upstream flood control improvements), flood depths will reach 8 to 11 feet in ponds A5 to A8. As stated previously, any alternative that prevents flooding of ponds A5-A8 will likely require additional measures to protect Alviso.

4.6 ALTERNATIVES ANALYSES

Potential flood control alternatives for the Reconnaissance area include levees from UPRR downstream (possibly set-back from one or both banks), dredging the Alviso Slough channel, a ring-levee around Alviso, allowing flooding through A5-A8 via a flood easement, or combinations thereof. Various options would exist for the flood easement, including engineering an overflow weir from Alviso Slough for more efficient flow bypass, connecting Guadalupe and Alviso Sloughs together into one large flood corridor, and opening ponds A5-A8 to the bay.

Under present conditions, parts of the baylands Reconnaissance area (including Alviso and Cargill salt ponds) are susceptible to flooding under hydrologic conditions more frequent than the design flood. It is anticipated that flood control improvements upstream of the Reconnaissance area (the downtown and Lower Guadalupe River projects) will further increase the flows entering the baylands, up to about 20,000 cfs for the design flood. This will further exacerbate extent and depth of flooding in the baylands (Recon study area). Section 4.6 presents reconnaissance-level alternatives aimed at offsetting impacts from the Guadalupe River projects by preventing or reducing flooding to these downstream areas, and also presents a discussion on the potential environmental resource impacts to the Reconnaissance area (habitat, economic, cultural, etc.) resulting from the Guadalupe River project design flow of 20,000 cfs.

4.6.1 HYDRAULIC ANALYSES

4.6.1.1 HEC-RAS

HEC-RAS has been used to make comparisons between results of present analyses versus prior study results. Its versatile graphical interface eliminates the need to use multiple applications for comparing results. HEC-RAS has also been used when only steady-state, one-dimensional (single channel) hydraulic results were sufficient to address a question or issue (i.e. dynamic or time sensitive results were not necessary).

4.6.1.2 UNET

As stated previously in Section 4.4.2.1, the UNET model was chosen for baseline condition simulations because of its capability to simulate complicated interconnected channel/pond networks and unsteady flow (which HEC-RAS is unable to do). For these same reasons, and to provide for a consistent comparison to the baseline conditions, UNET was also used for the alternatives simulations. This included preliminary sensitivity analyses (as discussed previously in Section 4.5.1), followed by simulation of a "final" set of reconnaissance-level alternatives (presented in this section). The alternatives chosen are as follows:

- *Dredging*: the Alviso Slough channel is dredged with a bottom width of 24 m (about 80 ft), a bottom elevation of –2.5 m (-8.2 ft) and a 2:1 side-slope, extending from the Bay (Coyote confluence) upstream to Alviso at the overflow location into pond A8W. The bottom elevation of this alternative and side-slope were chosen to match dredging alternatives under investigation in the LGRFPP study, which extends upstream from Alviso. The bottom width of the LGRFPP dredge alternative is 40 m; however, available channel width between existing levees on Alviso Slough limits the channel width to only 24 m for the Reconnaissance alternative.

- *Alviso Slough levee raising*: the model was reconfigured to prevent any levee overtopping from Alviso Slough into the Cargill ponds or the town of Alviso. The channel and present levee locations would remain the same.

- *Alviso and Guadalupe Slough levee raising*: same as Alviso Slough levee raising (above) but with an increase in levee height also along Guadalupe Slough to prevent overtopping into Cargill ponds.

- *Engineered weir with Pump outflow*: the overflow from Alviso Slough into A8W would be changed to an engineered weir with a crest elevation of 10.17 (the present low spot in the levee) and length of 500 ft, with an additional overflow segment at elevation 15.5 and length of 287 ft. Pumps with 500 cfs capacity each are installed in the levees to empty storage areas A5 and A7 back into Guadalupe Slough and Alviso Slough respectively, at the north end of these ponds.

- *Marsh Accretion*: all the Knapp ponds A5 through A8 (including A6) are acquired, and are opened up to the tidal processes of the bay. Under this alternative, the levee at the north end of A6 along Coyote Creek would be breached. It is assumed that A6 and the remaining ponds A5-A8 would then generally accrete (fill with sediment) to mean high water (MHW) level. Tidal marsh vegetation would then emerge within this area. This alternative would free up A5-A8 as a conveyance corridor for floodwater, although the loss of storage and conveyance due to the accretion and vegetation resistance may limit the viability of this alternative for flood control. It is, however, considered an environmentally viable alternative. Because the accreted A5 to A8 area would function as a conveyance corridor with significant vegetation resistance instead of individual storage cells, the ponds were converted in the UNET model to a channel reach extending from near Alviso to Coyote Creek. Cross-sections were created within this reach to reflect the accreted marsh levels and the large width of the corridor, extending from the Guadalupe Slough levee on the southwest to the Alviso Slough levee to the northeast.

The alternatives presented above were simulated using the UNET model. Results are summarized in Table 4-7. Specific discussion of the alternatives' results, as they pertain to specific key sites, is presented in the following chapter (Section 5.1.3).

4.6.1.3 RMA-2

Under previous analyses of flood risk reduction along Alviso Slough, a two-dimensional concept-level (pre-reconnaissance) simulation was performed to investigate the potential of setting back the west Alviso Slough levee in an effort to increase the conveyance capacity from UPRR out to the bay. Figure 4-17 presents a plan view of this possible alternative solution. The June 1998 report, "*Preliminary Geomorphic and Hydrodynamic Assessment of the Guadalupe River, Alviso Slough, Guadalupe Slough and its Tributaries, and the Cargill Salt Pond System.*"

Table 4-7. Alternatives Comparison Of Maximum Water Depths (ft)

Design Event, Future Conditions

SITE	Baseline condition (no alt.)	Dredge Alviso Slough	Alviso Slough Levee	Guadalupe & Alviso Slough Levees	Engineered Weir & Pump	Marsh Accretion[1]	Marsh Accretion[2]
Alviso	0.6	0.5	0.4	0.4	0.4	1.5	1.7
NCM Canal	7.2	7.2	7.2	7.2	7.2	7.2	7.2
New Chicago Marsh	3.9	3.9	3.9	3.9	3.9	3.9	3.9
Rincon De Los Esteros	0.1	0.1	0.1	0.1	0.1	0.1	0.1
A3E	0.2	0.2	0.2		0.2	0.6	0.9
A3W						Nominal	0.2
A5	8.5	7.7	0.7		8.6	5.8/9.8	5.7/9.7
A7	8.7	7.7			8.8	5.1/9.1	5.1/9.1
A8D	8.8	7.7	1.5		9.0	6.2/10.1	
A8W	11.1	10.0	1.2		11.4	6.4/12.7	6.6/12.9
A11							
A12	0.6	0.7	0.3	0.3	0.2	1.9	2.0
A13	1.6	1.6	1.7	1.7	1.6	2.2	2.4
A15	1.1	1.1	1.2	1.2	1.1	1.1	1.1
A16							
A17							

NOTES: 1. Elevations in A5-A8 under Marsh Accretion: first number represents flood depth above accreted bed, second number represents equivalent flood depth above original bed (for comparison purposes to other alternatives). Inundation depths in A6 are unknown due to lack of adequate topographic data and surrounding levee geometry.

2. Marsh Accretion alternative was run a 2nd time with pond A8D protected by levee,& all overflow into A8D disabled.

4.6.2 ENVIRONMENTAL IMPACTS ANALYSES

The following sections present a preliminary discussion of the potential impacts that project alternatives would have on existing environmental resources, primarily as a result of construction of project and bayland alternatives and the operation of the downtown and lower Guadalupe River projects increasing the project design flow. Discussions herein are organized by topic. Note that construction-related impacts are considered separately from operation-related impacts, where applicable. The lead agency will be ultimately responsible for determining whether impacts are significant in the EIS/EIR. Final analysis and determinations of significance are therefore deferred until the preparation of the EIS/EIR.

4.6.2.1 Geology and Soils

No substantial impacts on geology and soils are expected to result from construction or operation of the proposed project. However, the design of structural components included in various bayland alternatives (e.g., levees, flow control mechanisms, engineered overflow) must be compatible with constraints imposed by the nature of local substrate materials. Substrate constraints may include soils of relatively low density (possibly collapsible soils), unstable substrates, and potential for seismically induced liquefaction of some substrates.

4.6.2.2 Land Use

Based on a preliminary analysis, no substantial impacts on land use are expected to result from implementation of the project. Construction of the proposed project may result in minor, temporary land use impacts. Specifically, construction of setback levees might conflict with existing or planned land uses and would require coordination with landowners. Flooding resulting from operation of the project could disrupt existing land uses, although this impact would likely be minor because it would be temporary and would not represent a substantial change from existing conditions. Flooding would not likely divide the Alviso community physically, nor would it conflict with existing land use plans, policies, or regulations for the town of Alviso.

The City of San Jose is developing a new Master Plan for the Alviso Marina. Project alternatives that include constructing or improving levees around Alviso may conflict with this new master plan for the marina. This requires further investigation and analysis.

4.6.2.3 Socioeconomics

Construction of the proposed baylands alternatives are not expected to have substantial socioeconomic impact, although construction of levees in Alviso may temporarily disrupt some businesses and recreation facilities, which would have a temporary impact on the area's economy. Operation under the project design flood (expected to be 20,000 cfs)may result in two adverse socioeconomic impacts, as defined under NEPA. These impacts are discussed in greater detail in the following sections. Note that CEQA does not consider economic or social effects as environmental impacts unless they physically affect the environment. Because socioeconomic impacts are not expected to result in a physical effect on the environment they are not subject to CEQA analysis.

4.6.2.3.1 Economic Effects on Alviso and Cargill

Operation under the project design flood (expected to be 20,000 cfs) could have both direct and indirect impacts on Alviso's economy. Potential direct impacts to the community of Alviso may include: flooding could damage private property such as housing and small businesses. Under a worst-case scenario, businesses could close and buildings become abandoned, which might result in physical deterioration or damage from vandalism. Potential indirect impacts may include: A temporary decline in patronage of Alviso businesses during floods would likely have an adverse economic effect on these businesses. It could also substantially affect the quality of the human environment and public health and safety. Operation of the project may also have a substantial adverse impact on Cargill's salt production. The salt production cycle takes five years from input of bay water to final harvesting. Heavy rains are known to set back production by as much as a year and a major flood event can also set the process back substantially. Inundation of the salt ponds under project design flow conditions could delay salt production beyond the current worst-case scenario. Other economic effects could include damage to existing levees and structures and deposition of flood debris in ponds and on levees. NEPA would not require mitigation for these impacts.

4.6.2.3.2 Environmental Justice

Executive Order 12898 ("Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," issued 2/11/94) directs the U.S. Environmental Protection Agency (EPA) to ensure that lead agencies specifically analyze the environmental effects of proposed projects on minority and low-income communities. The purpose of Executive Order 12898 is to ensure that minority and low-income populations are not disproportionately affected by adverse environmental, economic, social, or health impacts resulting from federal actions and policies. Under NEPA, the effects of a proposed project on minority and low-income populations must be specifically considered in a NEPA document.

As discussed in the "Socioeconomics" section of this report, 1990 census data indicate that the proportion of both low-income and minority residents is higher in Alviso than in San Jose as a whole. Assuming that current demographics remain unchanged, the flooding effects of the proposed project would therefore have a disproportionate effect on low-income and minority residents in San Jose. Thus, under Executive Order 12898, District must consider feasible alternatives for reducing or mitigating these disproportionate effects. A more extensive analysis will be required in the EIS/EIR in order to quantify the socioeconomic differences between Alviso and the surrounding area.

4.6.2.4 Air Quality

No substantial impacts on air quality are expected to result from construction of the bayland project alternatives or operation the Lower Guadalupe and downtownprojects. Project construction would result in a temporary increase in dust and vehicle emissions associated with construction activities such as earthmoving and dredging. Otherwise, project alternatives will have little to no effect on the air quality in the area.

4.6.2.5 Water Quality

No substantial impacts on water quality are expected to result from construction or operation of the project. The dredging alternative may release contaminants into San Francisco Bay that are currently stored in the fine sediments of the channel bed and banks; these include mercury, copper and nickel. (Southern San Francisco Bay and the Guadalupe River are both on the list of California waters considered impaired for mercury, copper, nickel, selenium, diazinon, and polychlorinated biphenyls or PCBs under Section 303(d) of the federal Clean Water Act.) Construction and dredging may also increase short-term turbidity in the Reconnaissance Study Area. Operation of the project will have little to no effect on water quality under conditions up to and including the design floodflow.

4.6.2.6 Vegetation

4.6.2.6.1 Sensitive plant communities

Construction of the proposed bayland project alternatives may have adverse impacts on sensitive plant communities. Sensitive plant communities are known to occur throughout the Reconnaissance Study Area; salt marsh, brackish marsh, diked salt marsh, freshwater marsh, and riparian woodland and forest are all considered sensitive communities by CDFG. The dredging alternative would remove or disturb large amounts of salt marsh, brackish marsh, and freshwater marsh habitat in Alviso Slough. These impacts would likely require substantial mitigation. In addition, construction of levees (included in multiple alternatives) may have substantial impacts on the Reconnaissance Study Area's sensitive wetlands and jurisdictional wetlands. Surveys of vegetation and jurisdictional wetlands will be required to assess the extent of these impacts.

No substantial impacts on sensitive plant communities are expected to result from operation of the Lower Guadalupe River and Downtown projects. Operation under the design floodflow may increase the duration of flooding in sensitive habitats. However, flood depth is not expected to increase substantially.

Therefore, impacts on sensitive plant communities resulting from operation of the proposed project are expected to be minor.

4.6.2.6.2 Special-Status Plant Species

The only special-status plant known to occur in the Reconnaissance Study Area is Congdon's tarplant. Plant surveys will be required prior to construction of levees to determine the possible effects of construction on populations of special-status plants. Operation of the proposed project is unlikely to affect Congdon's tarplant, because the growing and flowering period of Congdon's tarplant does not coincide with the flood season.

4.6.2.7 Wildlife and Fisheries

Construction and operation of the proposed project may result in adverse impacts on fisheries and wildlife. Many special-status wildlife species use habitats in the Reconnaissance Study Area. The design floodflow could disrupt foraging use by species that winter in the Reconnaissance Study Area. However, because of the wide availability of similar habitat and the short duration of flooding, most species will likely incur only minor impacts. The following sections discuss potential impacts on special-status wildlife species known to occur within the Reconnaissance Study Area.

4.6.2.7.1 Western Snowy Plover

Operation of the project would result in flooding in an area projected to include salt pond A8D, where western snowy plovers nest. Pond A8D is not listed as critical habitat for the western snowy plover. However, USFWS does recognize the plover populations which use southern San Francisco Bay salt ponds as important to the survival of the species. Plovers are known to breed in the Reconnaissance Study Area and to disperse from nesting sites there to other parts of coastal and inland California, improving plover populations throughout the state. Peak adult counts in the Pond A8D range from 0 to 20 adults (averaging 9 adults) from 1984 to 1997, with a peak nest count of 19 in 1996.

Flooding of pond A8D may have an adverse impact on the small breeding population of plovers in pond A8D. Under design floodflow conditions, pond A8D would likely flood to a depth of over 8 feet (Table 4-3). With an evaporation rate in southern San Francisco Bay of approximately 55 inches per year (Blaney and Muckel 1955), 8 feet of water (without pumping) would take approximately 1.7 years to evaporate completely. This could displace breeding birds for two breeding seasons. Under existing worst-case conditions, pond A8D is predicted to flood to a depth of approximately 3.5 feet. Without pumping, an event of this size requires 8 to 9 months to evaporate, and only affects birds for one breeding season. Mitigation would likely be required to avoid or minimize the impact of project operation on breeding plovers. Possible mitigation measures include pumping water out of pond A8D after flood events to allow breeding populations to return to the pond sooner, and protecting the pond by building up surrounding levees to prevent or reduce flooding.

4.6.2.7.2 California Clapper Rail

Construction of some bayland project alternatives could have a significant impact on California clapper rails and their habitat. The dredging alternative and the continuation/extension of the Guadalupe River would remove or disturb substantial amounts of clapper rail habitat along Alviso Slough. At the very least, extensive mitigation would be required, and detailed studies would be necessary to determine the long-term effect of dredging on the species. Due to the regional importance of the habitat in the Reconnaissance Study Area for California Clapper Rails, the FWS may not permit the dredging alternative under the Endangered Species Act.

Operation of the Lower Guadalupe River and Downtown projects will have at most minimal impacts on clapper rail populations. The period of potential flooding overlaps only briefly with the clapper rail breeding period, so the potential is extremely low that the design flood event would occur during the breeding season. Moreover, clapper rails affected by flood events could return after the floodwaters recede to attempt to raise a brood during the same season. The duration of projected flooding could be longer under project conditions than under existing conditions, but the depth of flooding is not expected to be significantly higher in the sloughs used by clapper rails. The lower sloughs are tidally dominated, and there is little difference in terms of habitat usage between tidal flooding and freshwater flooding.

4.6.2.7.3 Salt Marsh Harvest Mouse

Construction of the proposed project is expected to affect salt marsh harvest mouse populations in the project area. The dredging alternative could remove or disturb a substantial amount of salt marsh harvest mouse habitat. Proposed improvements in Alviso Slough levees also have the potential to remove or disturb salt marsh harvest mouse habitat.

Operation of the proposed project is not expected to result in further impacts on salt marsh harvest mouse habitat. Project design flooding will not increase flood depths in salt marsh harvest mouse habitat significantly beyond those that occur under existing conditions. For example, with construction of the proposed project, the design flood (20,000 cfs) is expected to increase overall flood depths in New Chicago Marsh by only a few tenths of a foot (see Table 4-3). In the tidally influenced lower reaches of Coyote Creek and Alviso Slough, implementation of the proposed project would produce very little change in flood stage under the design flood event. Under existing conditions (and by inference, under project conditions as well) large flood events are known to reduce salt marsh harvest mouse populations temporarily, but populations are quick to rebound (Duke pers. comm.).

4.6.2.7.4 Burrowing Owl

Construction of the setback levee alternative could displace nesting burrowing owls. However, at least two possible mitigation measures are available to compensate for the loss of burrowing owl habitat. These are: (1) procedures established by CDFG, and (2) provisions of the *Draft Burrowing Owl Habitat Conservation Strategy and Implementation Plan* currently in preparation by the City of San Jose. Artificial burrows are also known to be successful in mitigating the loss of burrowing owl nesting habitat. Furthermore, the banks of new levees may provide additional nesting sites. Surveys for burrowing owls will be required prior to the completion of the project EIS/EIR.

Operation of the proposed project is unlikely to affect burrowing owl populations even under the maximum projected (design) flood event. Flooding may occur during the breeding season (February 1 to August 31), but late spring and summer are typically the dry seasons in the project area and flooding is unlikely during this period. In any case, burrowing owl nesting habitat would probably only be flooded for a short period of time, because any flooding that might occur would likely be of short duration. Owls would probably be able to return to the nesting site once floodwaters receded.

4.6.2.7.5 Salt Marsh Common Yellowthroat

Construction of the proposed project may result in adverse effects on the salt marsh common yellowthroat. The dredging alternative would disturb or remove a substantial amount of salt marsh common yellowthroat habitat. Levee construction alternatives may also remove small amounts of habitat suitable for this species.

Operation of the proposed project is unlikely to affect salt marsh common yellowthroat populations even under the maximum projected (design) flood event. In the Reconnaissance Study Area, the salt marsh common yellowthroat is primarily found in tidally dominated marshes along the area's downstream sloughs. This environment experiences regular inundation as a result of tidal currents. Flooding may occur during the salt marsh common yellowthroat's breeding season, but this is very unlikely, and in any case there is very little difference between tidal and fluvial flooding in terms of impacts on breeding bird populations.

4.6.2.7.6 Fish

Construction of the dredging alternative could increase turbidity in the Guadalupe River. High concentrations of suspended sediment can suffocate fish. Construction would presumably take place during the summer, when migrating adult salmonids are not likely to be present in the Reconnaissance Study Area. However, presence/absence surveys should be conducted for juvenile steelhead trout and chinook salmon prior to dredging.

Operation of the proposed project is unlikely to have a substantial effect on fisheries resources in the Reconnaissance Study Area even under the maximum projected (design) flood event. However, flooding is most likely to occur during the out-migration period for anadromous species. As a result, steelhead trout and chinook salmon smolts may be carried into overflow structures and stranded in the evaporation ponds as floodwaters recede. This could be considered as take under the Endangered Species Act; overflow structures should be designed to exclude juvenile fish from the evaporation ponds to prevent take of steelhead and chinook.

4.6.2.8 Cultural Resources

Construction of the proposed project could result in adverse impacts on cultural resources in the Reconnaissance Study Area. The setback levee alternative and the extension/continuation of the Alviso Slough levee could disturb the National Historic District of Alviso; depending on the severity of this impact, mitigation may be required. The design alternative could also adversely impact cultural resources. In addition, all areas that will incur surface disturbance during project construction should be surveyed for cultural resources in order to assess the cultural resource impacts likely to result from project construction and to design appropriate mitigation measures.

Operation of the proposed project, even under the design flow, is not likely to change cultural resources impacts from existing conditions.

4.6.2.9 Recreation

Construction of the proposed project may affect recreational resources in the Reconnaissance Study Area. Over the short term, recreational use may be temporarily disrupted in and near construction areas. Over the long term, depending on the alternative selected, construction may eliminate existing recreational resources, or it may create new resources such as trails on new levees or improved boat access to Alviso as a result of dredging. The extent of these effects requires further analysis.

Operation of the proposed project under design flow conditions may affect recreational resources in the Reconnaissance Study Area. Flooding may damage the levee trail system; maintenance and cleanup would almost certainly be required to allow trails to reopen after a project design flood event. Other possible adverse effects of a design-flow flood event include disruption of activities at both Alviso Marina County Park and the Alviso Yacht Harbor, and disruption of recreational use at locations in Alviso Village, including Alviso Park and the Pinhigh Family Golf Center. Further analysis is needed to determine the likely severity of these impacts.

5 RESULTS AND CONCLUSIONS

5.1 HYDRAULIC PERFORMANCE

5.1.1 BASELINE CONDITIONS

As discussed in section 4.4.3, flood conveyance capacity of the sloughs within the Reconnaissance area has been restricted by the past confinement of the channels from a distributary system to narrower single channels. This has been followed by a resulting long-term trend of the channel to change from a channelized trapezoidal cross-section to a bench-accreted tidally influenced cross-section, which further restricts the channel conveyance capacity.

Under present upstream channel conditions, it is estimated that only about 14,000 cfs discharge would reach the Reconnaissance area from the Guadalupe River. Under this present flow condition with the existing Reconnaissance channels, a significant amount of flow overtops the levee into Cargill pond A8W. This helps to prevent flooding in Alviso, which would flood by up to about 0.7 ft depth (from Guadalupe River through the County Marina) if this overtopping were otherwise prevented (see Table 4-3). However, Alviso is subject to flooding from the North First Street corridor resulting from Lower Guadalupe River overtopping. Assuming that future upstream flood control improvements allow the full design hydrograph (20,000 cfs peak) to reach the Reconnaissance area, flood depths to both Alviso and most Cargill ponds would increase significantly. Alviso would be especially hard hit if Cargill A8W overflows were then prevented as well. Both Alviso and Rincon de Los Esteros are also susceptible to flooding from Coyote Creek to the north (via the New Chicago Marsh and canal). The effect of tides on potential flooding to these areas has also been amplified by past land subsidence that occurred primarily between 1934 and 1967.

5.1.2 ALTERNATIVES ANALYSIS

The baylands Reconnaissance area presently floods from runoff associated with storms significantly smaller than the present design event (14,000 cfs from Guadalupe River, and 6,000 cfs from N. First St.). This results in flooding from Guadalupe River to the town of Alviso and the Cargill salt evaporation ponds. The sloughs passing through the baylands have insufficient capacity to safely convey even a 10-year event without overtopping. Flood risk to the Reconnaissance area will further increase with completion of the upstream flood protection projects on the Guadalupe River. Regardless of the final project alternative chosen for the LGRFPP, it will be expected to convey the entire design event to the baylands and increase the resulting inflow to the Reconnaissance area by about 43 percent (to 20,000 cfs). Under these flow conditions, it has been estimated that Alviso will flood by at least 0.6 ft, that flood depths in Cargill ponds A5-A8 will approximately double to between 8 and 11 ft deep, and that other areas essentially without present overtopping would begin to flood (including Cargill ponds A3E and A12, and possibly Rincon de Los Esteros). As a result of these expected impacts from the LGRFPP, an alternatives analysis for the Reconnaissance study area was undertaken. The UNET simulations presented in the previous chapter looked at an extensive sensitivity analysis (Section 4.5.1), the results used to formulate reconnaissance-level flood control alternatives (Section 4.6.1.2). Results of these analyses, as they pertain to key areas of flood risk, are summarized below.

Town of Alviso: The intent of the analyzed alternatives is to reduce or eliminate flooding primarily along Alviso Slough, under future design flow (20,000 cfs) conditions, thus mitigating potential impacts due to upstream flood control improvements on the Guadalupe River from the LGRFPP project (resulting in the full 20,000 cfs reaching Alviso Slough). Overflows into Alviso from the Marina only partially contribute to flooding of the town of Alviso, as overflows from Coyote Creek also contribute (via New Chicago Marsh canal, New Chicago Marsh, and Rincon de Los Esteros). In terms of only mitigating for upstream

Guadalupe River improvements, either a levee option or the engineered weir option would appear to be sufficient whereas dredging only removes part of the impact. However, further measures would be required to keep Alviso in the complete dry from Coyote Creek. Rincon de Los Esteros to the east is also at minor flood risk (0.1 ft depth) due to Coyote Creek. Protecting these areas from flooding have little impact to other areas within the Reconnaissance study (such as the Cargill ponds). Alviso and Rincon De Los Esteros are still susceptible to flooding resulting from excess North First Street runoff exceeding the capacity of the municipal storm drainage infrastructure.

Cargill Ponds A5 to A8: As discussed under the sensitivity analysis, a levee only along Guadalupe Slough to protect these ponds would be counter-productive, and was therefore not included as a final alternative. A levee just along Alviso Slough would greatly reduce flood levels, but only an Alviso Slough and Guadalupe Slough combined levee option keeps ponds A5-A8 completely from flooding. On Alviso Slough, levee improvements may be quite intensive in order to pass the full 20,000 cfs down to the Bay. Water surface profiles on Alviso Slough for this alternative will increase by about 1 ft at the downstream end and by up to 4 ft near Alviso (downstream of UPRR). Including freeboard this would involve significant levee raising in places. Levees would be required on both sides of the channel at least adjacent to Alviso, but may also need to be extended downstream to protect ponds A10 to A12. On Guadalupe Slough, levee improvements would be less intensive, with expected water levels to increase only 1 ft or less. The dredge alternative reduces flood levels by about 1 ft, but the ponds would still flood to almost 8 ft deep (10 ft deep in A8W).

The other two alternatives, an engineered weir into A8W and marsh accretion of A5-A8, allow and encourage flooding in the A5 to A8 areas, which would require a flood easement or acquisition (SCVWD:Ferguson, 2000). The engineered weir overflow does effectively mitigate for flooding in the town of Alviso due to upstream flood control projects on the Guadalupe River, and also reduces flooding in Cargill pond A12 from 0.6 ft to 0.2 ft. It raises water levels in ponds A5-A8 two or three tenths of a foot, but considering that water depths are otherwise between 8.5 and 11 ft already, this is not a significant increase. Further sensitivity analysis with pumping from A5 and A7 back into Guadalupe and Alviso Sloughs suggests that, at 500 cfs capacity, there is no benefit by lowering peak water levels within A5-A8, although it would help reduce the duration of pond inundation by helping to drain the ponds. Larger capacity pumps could provide additional reduction in peak water levels, but may be prohibitively expensive. The marsh accretion alternative, on the other hand, is shown to have no flood control benefit within the Reconnaissance area. Even though the A5-A8 area would be opened up to conveyance of floodwater from Alviso and/or Guadalupe Sloughs, the tidal influences (bed accretion, high resistance of marsh vegetation, and high tides) do not allow for efficient conveyance of overflows from the sloughs. In fact, backwater in this area actually increases submergence on the levees and thus reduces the amount of weir overflow from Alviso and Guadalupe Sloughs. This induces more flooding on Alviso (by about an additional 1 ft) and the remaining Cargill salt ponds.

Other Cargill ponds: Of the alternatives studied, only the complete levee system on both Guadalupe and Alviso Sloughs will keep all ponds west of Alviso Slough dry (A3E, A3W and A5 to A8), although flooding of the A3 ponds is not extensive to begin with. The ponds to the east ("Alviso Ponds" A12, A13 and A15) continue to flood at close to the same depths, due to Coyote Creek. As stated previously, the remaining Cargill ponds would be impacted to some degree from the accretion of A5-A8 alternative. The marsh accretion alternative was run under two scenarios: allowing water into A8D and closing off A8D (to fully protect snowy plover habitat). Protecting A8D is shown in this alternative to impact other areas on the order of 0.1 to 0.3 ft (0.2 ft in Alviso). Based on existing available topography, Pond A4 doesn't appear to be at flood risk.

5.2 ENVIRONMENTAL PERFORMANCE

Based on this preliminary analysis, construction of the proposed LGRFPP project is expected to result in some adverse environmental impacts in the project area. However, the impact of constructing project flood-control alternatives would largely be confined to the footprint of facilities such as levees. Surveys will be required to determine whether such construction would affect sensitive resources such as wetlands, special-status species, and cultural resources.

Construction of the dredging alternative for the Alviso Baylands would likely result in substantial environmental impacts, including impacts on sensitive habitats, jurisdictional wetlands, and state- and federally listed species such as the California clapper rail. These impacts would probably either be unacceptable to resource and regulatory agencies, or would require substantial and costly mitigation. However, dredging may have beneficial impacts on recreation.

Operation of the proposed project under the design flood would likely have adverse impacts on human health and safety, cultural resources, and biological resources. The project would also adversely affect the economy of Alviso and would impact the production cycle of Cargill's salt ponds. These impacts would have a disproportionate affect on low-income and minority populations. Operation of the project under the design flood is expected to result in little to no effect on geology and soils, air quality, land use, and recreation.

5.3 CONCEPTUAL PREFERRED SOLUTION

The following is a summary of the preferred conceptual solution. This concept will be refined in future detailed analyses of the baylands. The preferred conceptual solution consists of:

- Easement acquisition of Cargill Ponds A5, A6, A7, A8W (wet) and A8D (dry pond);
- Construction of an engineered overflow weir between Alviso Slough and Cargill Pond A8W;
- Installation of pumping apparatus to evacuate floodwaters from Pond A8D following inundation of Pond A8D;
- Construction of outlet facilities, or pump stations, to evacuate floodwaters from Cargill Ponds A5, A7 and A8 as well as the USFWS Refuge (formerly Pond A6);
- Improve the Alviso Slough right levee (facing downstream) from UPRR Bridge to downstream of the County Marina inlet.

More detailed or advanced studies are required to evaluate the baylands conditions at a level of detail acceptable to develop designs, and to successfully complete environmental documentation (EIR and/or EIS). Chapter 6 identifies key additional activities necessary to advance the development of an acceptable solution to managing floodflows through the Baylands area.

5.4 PRELIMINARY COST ESTIMATE

A detailed cost estimate breakdown of the viable alternatives will be prepared by CH2M Hill and provided separately from this report.

5.5 RESULTS AND CONCLUSIONS

The town of Alviso is vulnerable to flooding from many directions and from many sources of floodwaters. The degree of flooding ranges from a few feet under present day conditions predominantly from North First Street flood flows to as much as 5-8 feet of potential flooding entering through the County Marina Parking Lot under Lower Guadalupe River and Downtown Guadalupe River Project conditions.

Alviso Slough lacks the capacity to convey present-day peak inflow from Guadalupe River and cannot contain the increased peak discharge for the design event The present-day capacity in Alviso and Guadalupe Sloughs is less than approximately 10,000 to 11,000 cfs, each. Alviso Slough can adequately convey around 6,800 cfs before flows begin overtopping a low spot along the west bank and discharging into pond A8. The Guadalupe River can deliver approximately 13,000-14,000 cfs to Alviso Slough under present-day channel conditions, thus exceeding the existing capacity of Alviso Slough even with flow spilling into pond A8. Once the Downtown and Lower Guadalupe River projects are completed the present day Alviso Sough will be incapable of containing the increased design flow from the flood control projects unless some improvements are made in the baylands downstream of the UPRR Bridge at Alviso.

Traditional means for increasing channel capacity, such as raising the levees from UPRR to the bay, or dredging of Alviso Slough, are not suitable in this case. Present slough levees are non-engineered structures with potentially inadequate foundation materials, limiting their ability to be adequately raised without significant expense. Raising the existing levees would likely require their complete demolition and replacement with new, higher levees requiring much larger foundations to support their weight in the bay mud environment. Environmental impacts to the Alviso Slough habitat and special status species could be significant, and expensive to mitigate. In addition, with the increased design flows, these structures would be required to be several feet higher than present-day levees near Alviso. Raising the levees in the baylands to contain and carry all flood flows to the bay will raise the water surface elevations in the baylands reach and cause higher water surface elevations upstream of UPRR. The resulting higher water surfaces upstream of UPRR will require the levees upstream of UPRR to also be heightened which is likely to lead to increased construction costs and more maintenance and environmental mitigation expenses.

Tidal processes and marsh accretion (daily sediment deposition in the slough channels) precludes the option of dredging. Dredging costs have to include initial capital costs, mitigation for initial impacts, and long-term frequent maintenance costs for re-dredging. A prime example of the extent and rate of sediment accumulation that occurs in this area exists at the County Marina at Alviso, which was abandoned due to the inability to perform maintenance dredging and is now completely filled in with sediment. Merely dredging the channel deeper does not improve hydraulic conveyance from UPRR to the bay because the entire dredged conveyance area is tidally submerged.

Due to the lack of channel capacity in Alviso Slough a combination of several flood mitigation components is required to reduce the threat of Guadalupe River flooding to the Town of Alviso and baylands area. Primary components include: (i) improvements to the west Alviso Slough levee and marina parking lot from UPRR bridge to downstream of the County Marina; (ii) construction of an engineered overflow weir on the west bank of Alviso Slough adjacent to pond A8D; (iii) flood easements for Ponds A5, A6, A7, A8W and A8D; and (iv) construction of outlet facilities or pump stations to evacuate floodwaters from Cargill ponds A5, A6, A7 and A8 following flood events. Installation of these four combined mitigation components will reduce flooding to the east of Alviso Slough. Construction of upstream flood improvements, including the Lower Guadalupe River and Downtown Flood Control Projects, will reduce flood risks along the North First Street corridor from flows breaking out of the Guadalupe River upstream of UPRR Bridge. However, management of Guadalupe River flows alone will not eliminate other sources of flooding risks to Alviso and the baylands. Therefore, if the ultimate goal is to eventually reduce all risks of flooding to Alviso and the baylands, additional regional planning and design is required, and is beyond the scope of this investigation.

Results from this study determined that the lands (salt ponds) between Alviso and Guadalupe sloughs are a vital component of any flood management solution. Historically, these lands were marshlands open to the bay and tidal processes. They were diked off for salt production in the early part of the 19th century. These lands are presently owned by private corporations such as Cargill Salt Company, or are Federal lands owned by the U.S. Fish & Wildlife Service. Periodic utilization of these lands as overflow detention is critical to any practical baylands flood control solution. Construction of high containment levees and/or channel dredging downstream of UPRR Bridge are not practical solutions. Therefore, the ability to complete and operate both the Downtown Guadalupe River Project and the Lower Guadalupe River Project to their respective capacities is entirely dependent upon accessibility of these baylands as a component of flood control.

Results from this study indicate that additional flood mitigation improvements are required in the baylands to protect Alviso, the County Marina, numerous Cargill salt ponds, U.S. Fish and Wildlife Refuge property, and other local public and private infrastructure in the baylands area, from increased flows that will be delivered from the combined Lower Guadalupe River and Downtown Guadalupe River Flood Control Projects. This reconnaissance study identifies several potential (conceptual) alternatives for mitigating flood risks downstream of the UPRR Bridge. However, advanced planning and design studies for the baylands are recommended to refine and substantiate a buildable solution.

Key conclusions from this reconnaissance investigation are:

- Alviso and surrounding private and public lands are highly susceptible to flooding today, and the flood risk is likely to worsen in the future due to sea level rise and man-induced changes in peak flow and watershed conditions upstream;
- It is essential to obtain flood easements for salt ponds A5 through A8 (including A6) as part of any flood mitigation solution in the baylands study area. Obtaining the flood easements becomes even more important once the Lower Guadalupe River and Downtown Guadalupe River Flood Control Projects come on line because peak flows delivered to the baylands may increase 14,000 to 20,000 cfs during the design event;
- This Reconnaissance Study has identified the flood risks and conceptual components of a flood mitigation plan for the baylands. Additional data and more detailed analyses are required to develop more comprehensive plans, designs and the necessary environmental (EIR/EIS) documentation required to implement a flood control project in the baylands.

6 RECOMMENDATIONS

The ability to manage flows during a design event flood along the Lower Guadalupe River and Alviso Slough (peak flows up to 20,000-cfs) requires a combination of baylands flood mitigation components including: (i) obtaining flood easements to temporarily store excess flood waters from Alviso Slough in Cargill salt ponds A5, A6, A7, A8W and A8D, and the FWS Refuge (formerly pond A6), (ii) construction of an engineered overflow weir on the west bank of Alviso Slough adjacent to pond A8D; (iii) constructing improvements to the west Alviso Slough levee and marina parking lot from UPRR bridge to downstream of the County Marina; and (iv) constructing outlet facilities or pump stations to evacuate floodwaters from Cargill ponds A5 through A8 following flood events. The following recommendations are aimed at managing Guadalupe River flood flows (up to the 20,000 cfs design event) from UPRR to the South Bay:

- Acquire flood easements for Ponds A5, A6 (FWS Refuge), A7, A8W and A8D.
- Install an engineered levee overtopping structure (flow control weir) on Alviso Slough's west levee across from the Town of Alviso to provide predictable overtopping flows into ponds A5 through A8 during major flood events.
- Install flow release tide gate structure(s) at the northwest end of the FWS Refuge to allow managed release of stored flood waters during periods of low tide.
- Determine if pumping is necessary to de-water critical environmental areas (like pond A8D or A6).
- Construct levee improvements west and north of Alviso along Alviso Slough and the County Marina to eliminate Guadalupe River induced flood flows from entering town.
- If Pond A8D is to be used for flood storage, then construct some elevated knolls or high features in the southwest corner to provide year-round snowy plover habitat (the details of such a plan can be determined in next study phase in cooperation with appropriate resource agencies). Optionally, a levee can be constructed to separate Pond A8D from A8W such that Alviso Slough overtopping flood flows cannot inundate A8D.
- This study raises the awareness of backdoor flooding to Alviso from New Chicago Marsh and the New Chicago Marsh Canal. Further investigation of these sources of flooding to Alviso and the baylands may be necessary during future planning studies.

More up-to-date data are necessary and additional detailed studies are required to evaluate the baylands hydraulic conditions at a level of detail acceptable to develop designs, and to successfully complete environmental documentation (EIR and/or EIS). Therefore, this study recommends consideration of the following future activities:

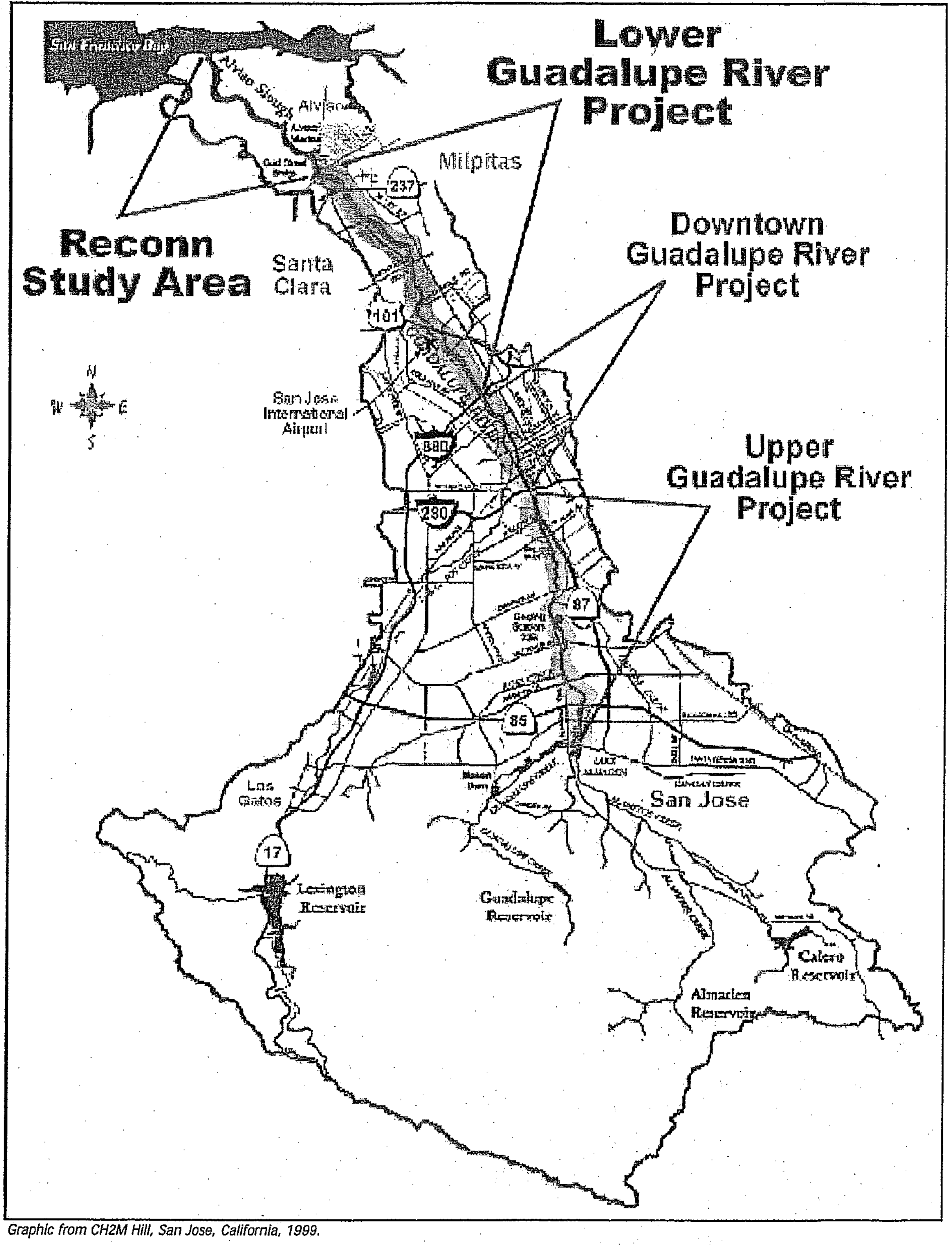
- Gather new and missing data (such as new channel and slough geometry, levee profiles, salt pond topography for the interior berms and pond inverts, geotechnical data for the levees, tide data in Alviso Slough, seasonal suspended sediment concentration data, and measurements to determine of constituents such as mercury are found in the baylands study area.)
- Perform a more comprehensive (quantitative) engineering and environmental assessment of flood risks and associated impacts, including impacts to critical habitat features;
- Prepare prudent baylands design criteria;
- Coordinate design plans with stakeholders and landowners; anticipate future conversion of the salt ponds to different types of land uses in the baylands;
- Complete the required environmental documentation (EIR/EIS) and associated hydraulic analyses, sedimentation assessments and other studies necessary to complete the EIR/EIS.

Additional environmental survey work is needed to assess the potential effects of several project alternatives in the detail required for the project EIS/EIR. At a minimum, the following surveys should be conducted for all project alternatives:

- Survey of ponds A8D and A6 for western snowy plover (immediately),
- Wetland delineation between UPRR and Alviso Marina,
- Environmental compliance analysis based on updated year 2000 census data,
    - extensive conceptual planning for restoration of ponds A5-A8 to tidal wetland habitat,
    - clapper rail and salt marsh harvest mouse surveys to determine levels of take under the ESA (only if the dredging alternative is pursued), and
    - analysis of the project's economic effects on Cargill operations.

In addition, in all areas of surface disturbance, surveys should be conducted for the following:

- burrowing owl,
- wetlands,
- sensitive plants, and
- presence of and potential habitat for other special-status species.



Graphic from CH2M Hill, San Jose, California, 1999.

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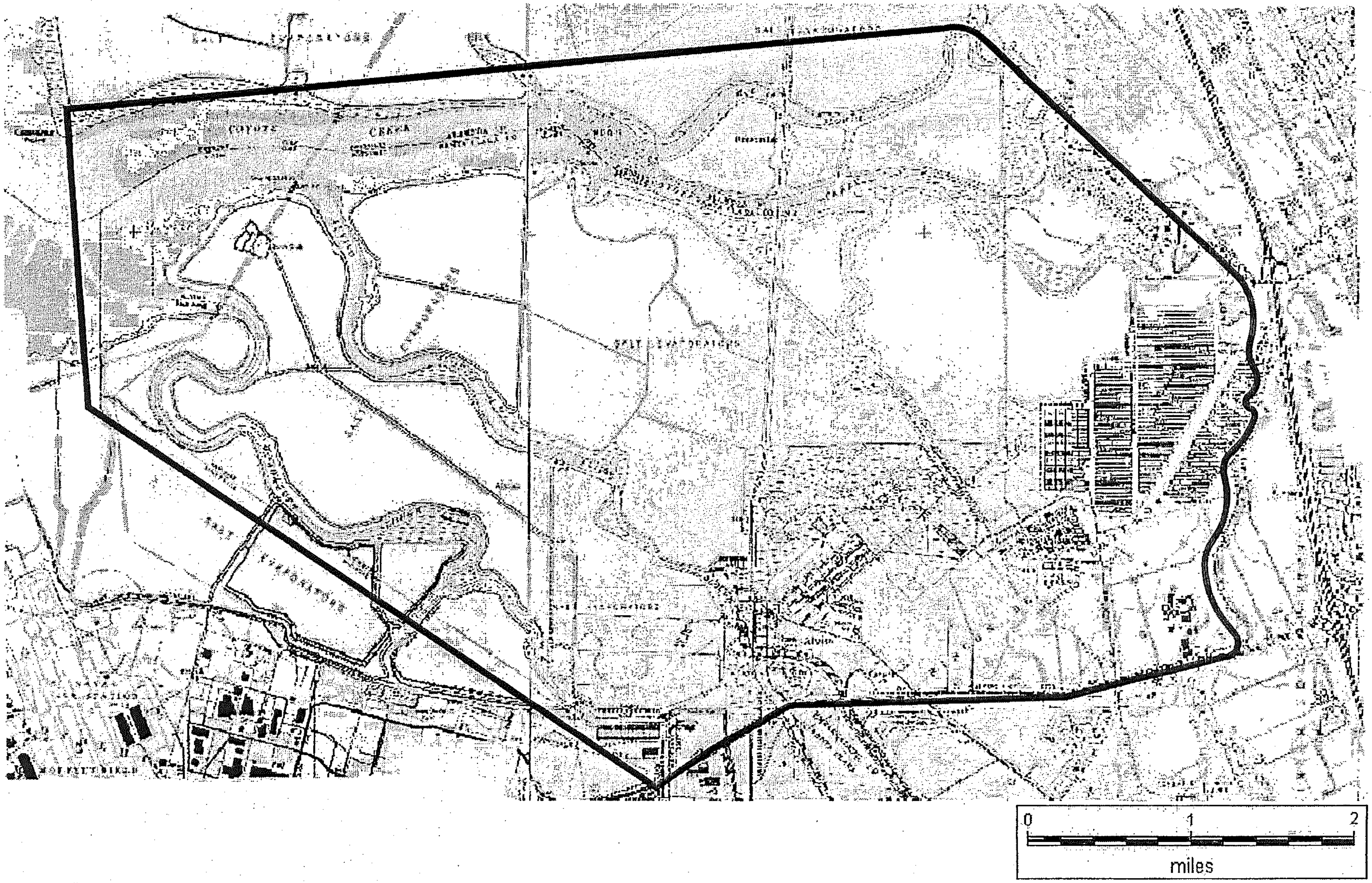
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
TASK 10 - RECONNAISSANCE STUDY
GENERAL LOCATION MAP

FIGURE
1-1



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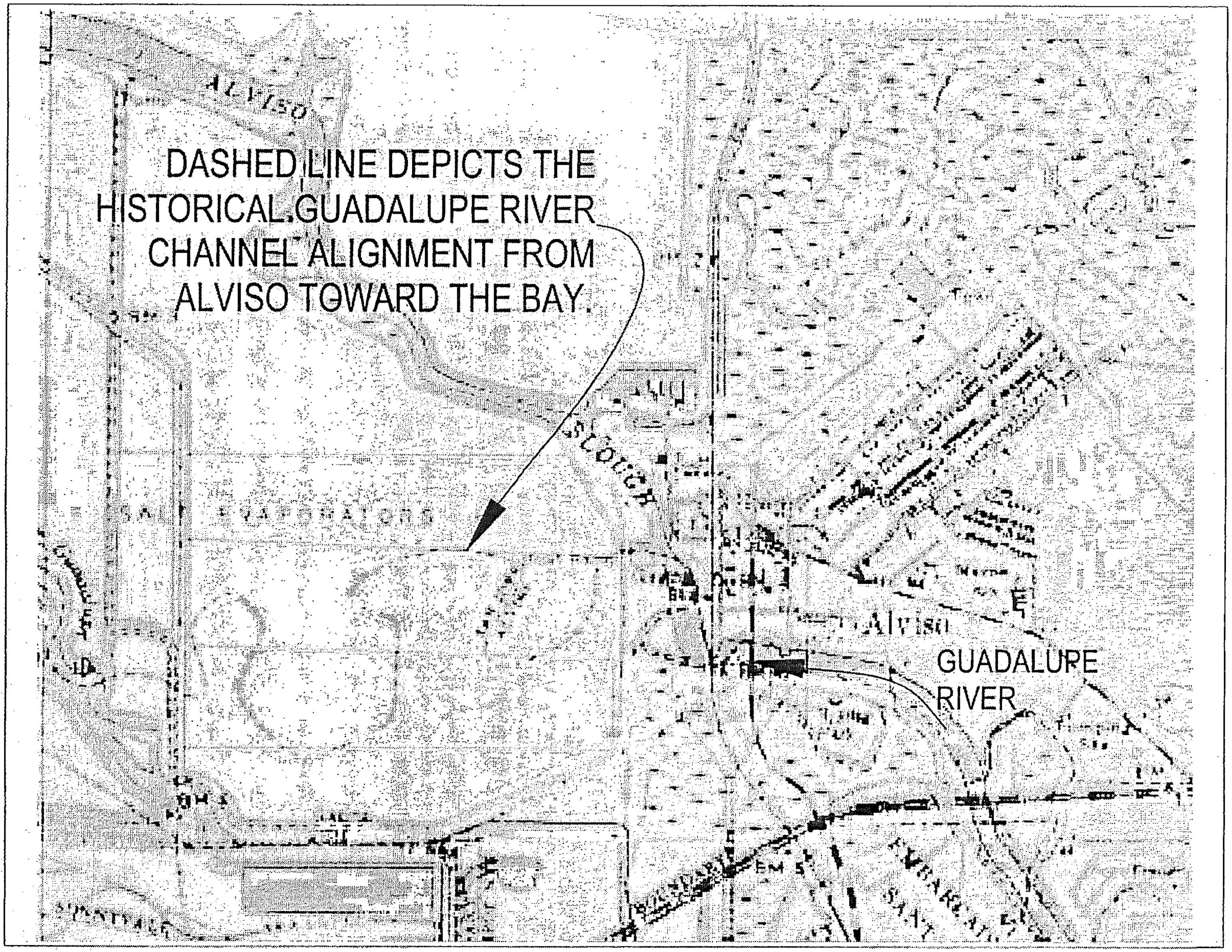
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
TASK 10 - RECONNAISSANCE STUDY
APPROXIMATE RECON STUDY BOUNDARY

FIGURE
1-2



ALVISO
SLOUGH
SALT EVAPORATORS
Alviso
DASHED LINE DEPICTS THE HISTORICAL GUADALUPE RIVER CHANNEL ALIGNMENT FROM ALVISO TOWARD THE BAY.
GUADALUPE RIVER
NORTH
NO SCALE

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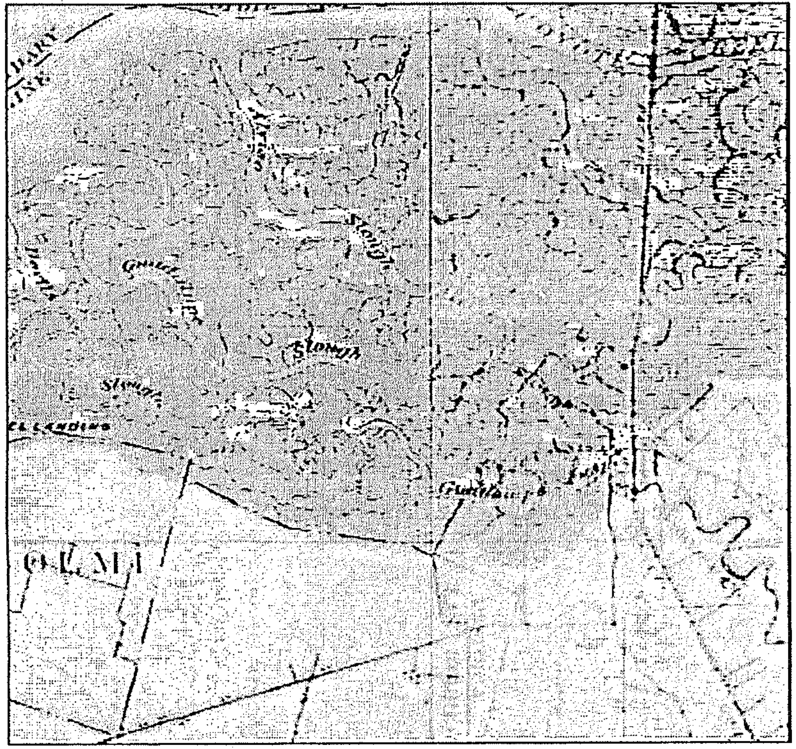
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
TASK 10 - RECONNAISSANCE STUDY
HISTORICAL GUADALUPE RIVER CHANNEL ALIGNMENT

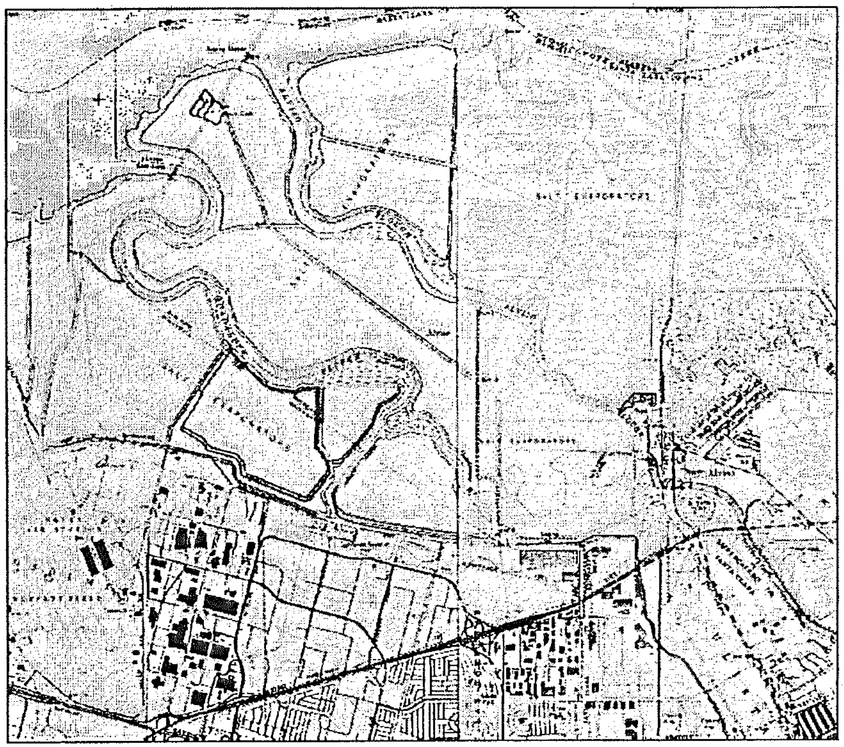
FIGURE 2-1

1895



Source: USGS 1:62500 scale topographic maps (Palo Alto, 1899, San Jose, 1899)

1991 | 1980



Source: USGS 1:24000 scale topographic maps (Mountain View, 1991; Milpitas, 1980)

- Images have been adjusted to depict the regions at approximately the same scale
- Historical maps acquired from California Division of Mines and Geology

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LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
CHANGES IN TIDAL MARSH FROM
LATE 1800'S TO 1980,1991

FIGURE
2-2

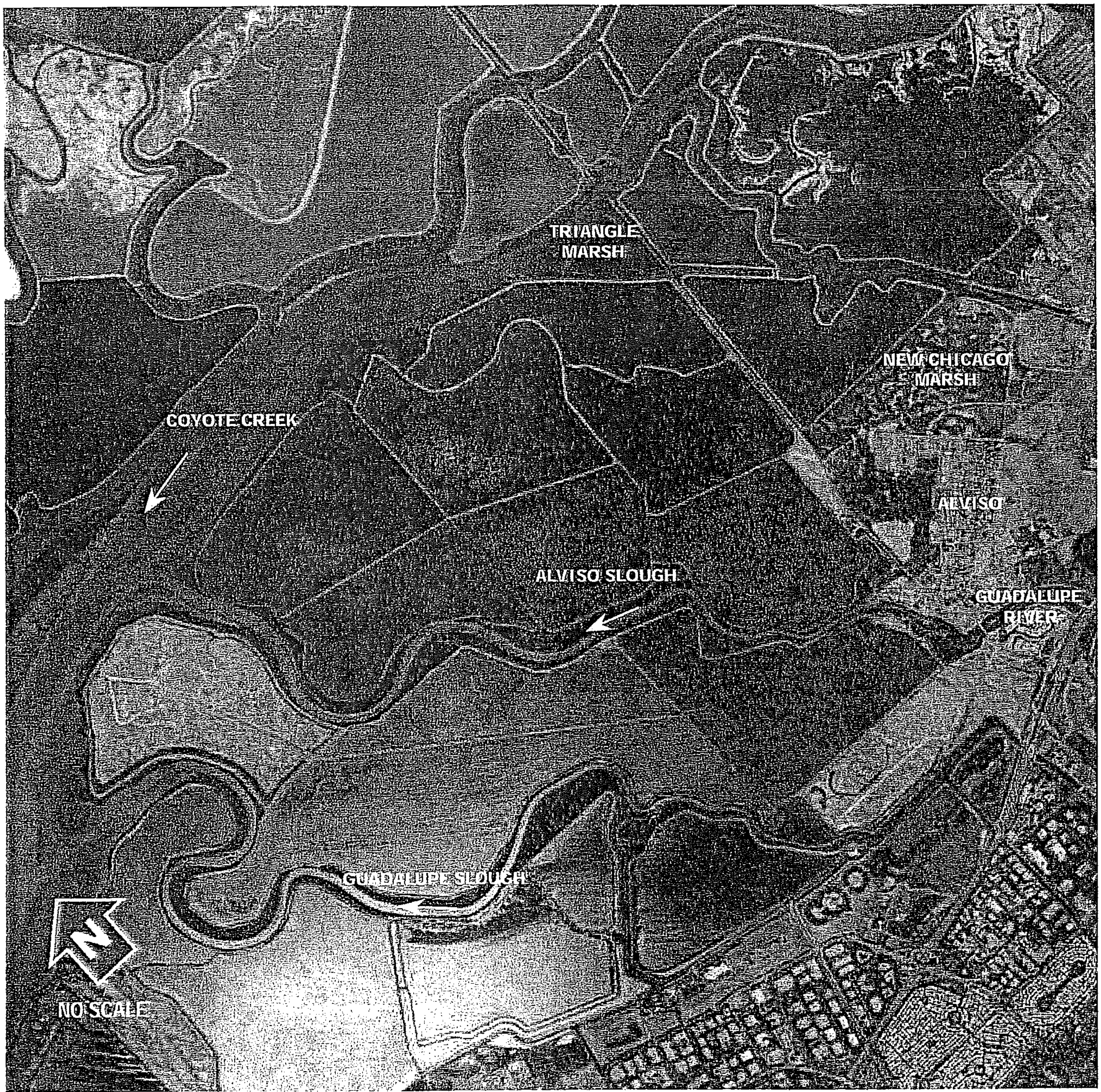

Image from August 1999 aerial surveys flown for Santa Clara Valley Water District as part of the Lower Guadalupe River Project.

Notes

- Pond depths vary, but are generally on the order of 2-4 feet deep.
- The ponds in this image are in the middle of a much longer chain of ponds used to circulate brine throughout the south bay to generate salt.
- The extent of the ponds depict the general location of historical tidal marshes in this part of the South Bay.

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LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY AREA
SALT EVAPORATION PONDS IN THE ALVISO AREA

FIGURE
2-3

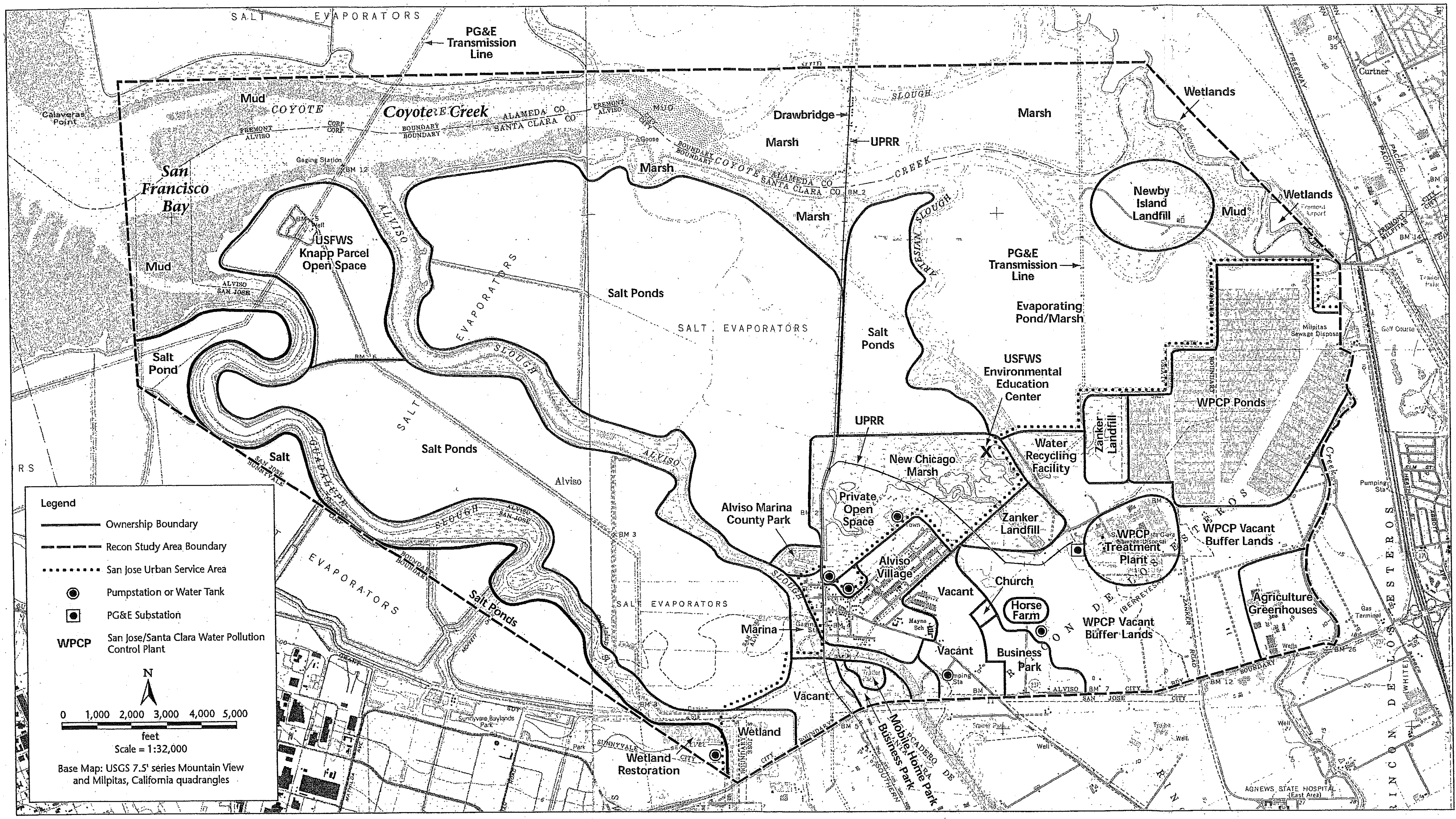
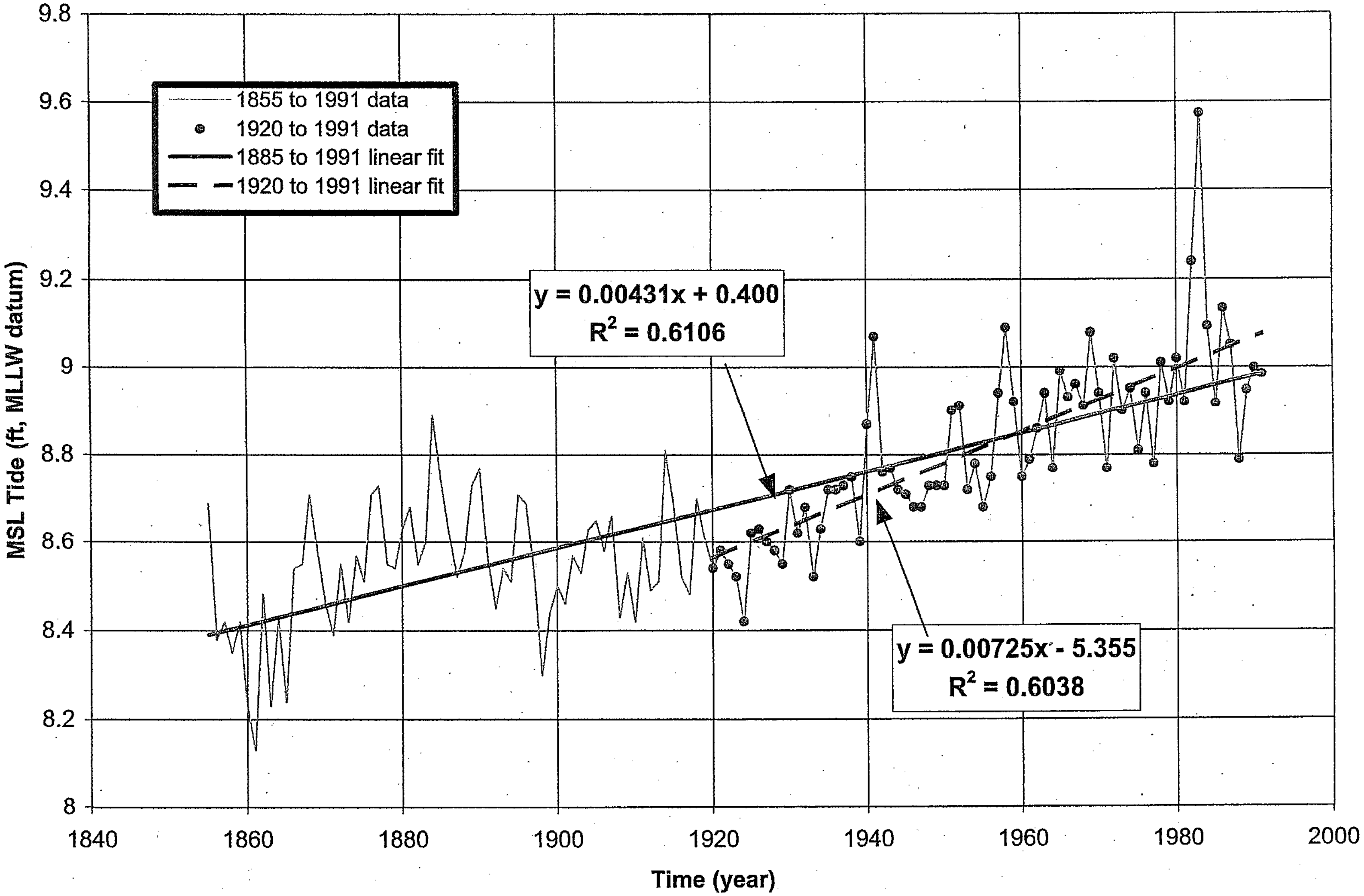


Figure 2-4
Existing Land Uses in the Recon Study Area

Annual Mean Sea Level Data, 1855-1991
San Francisco (Presidio) NOAA Station



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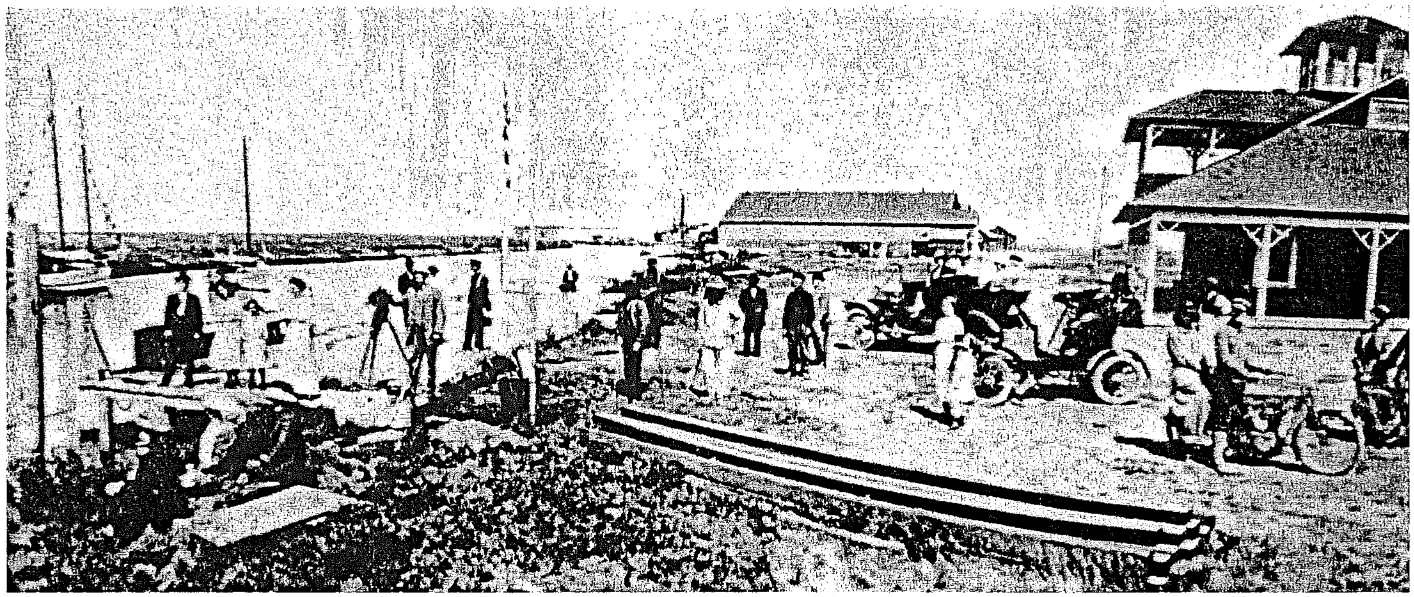
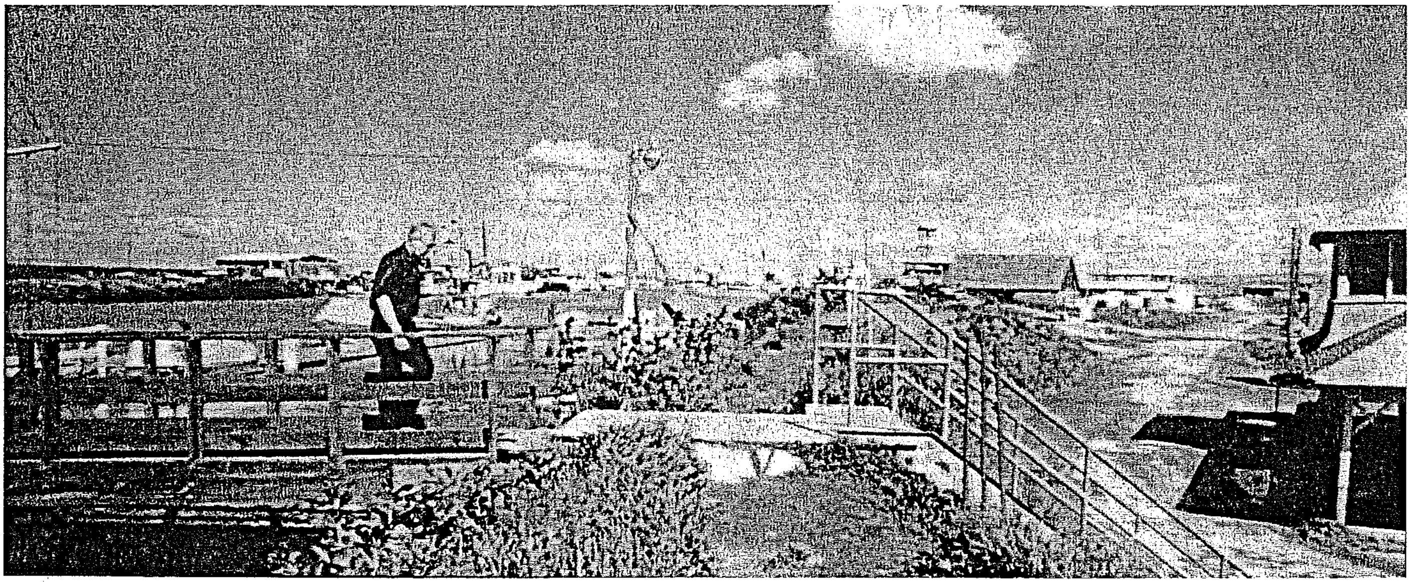
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
ANNUAL MEAN SEA LEVEL DATA 1855-1991
SAN FRANCISCO (PRESIDIO) NOAA STATION

FIGURE
3-1



ALVISO YACHT CLUB, circa 1914. The building at the right edge of the photograph is the clubhouse. The ground elevation next to the building appears to be slightly higher than the water surface in Alviso Slough to the left.



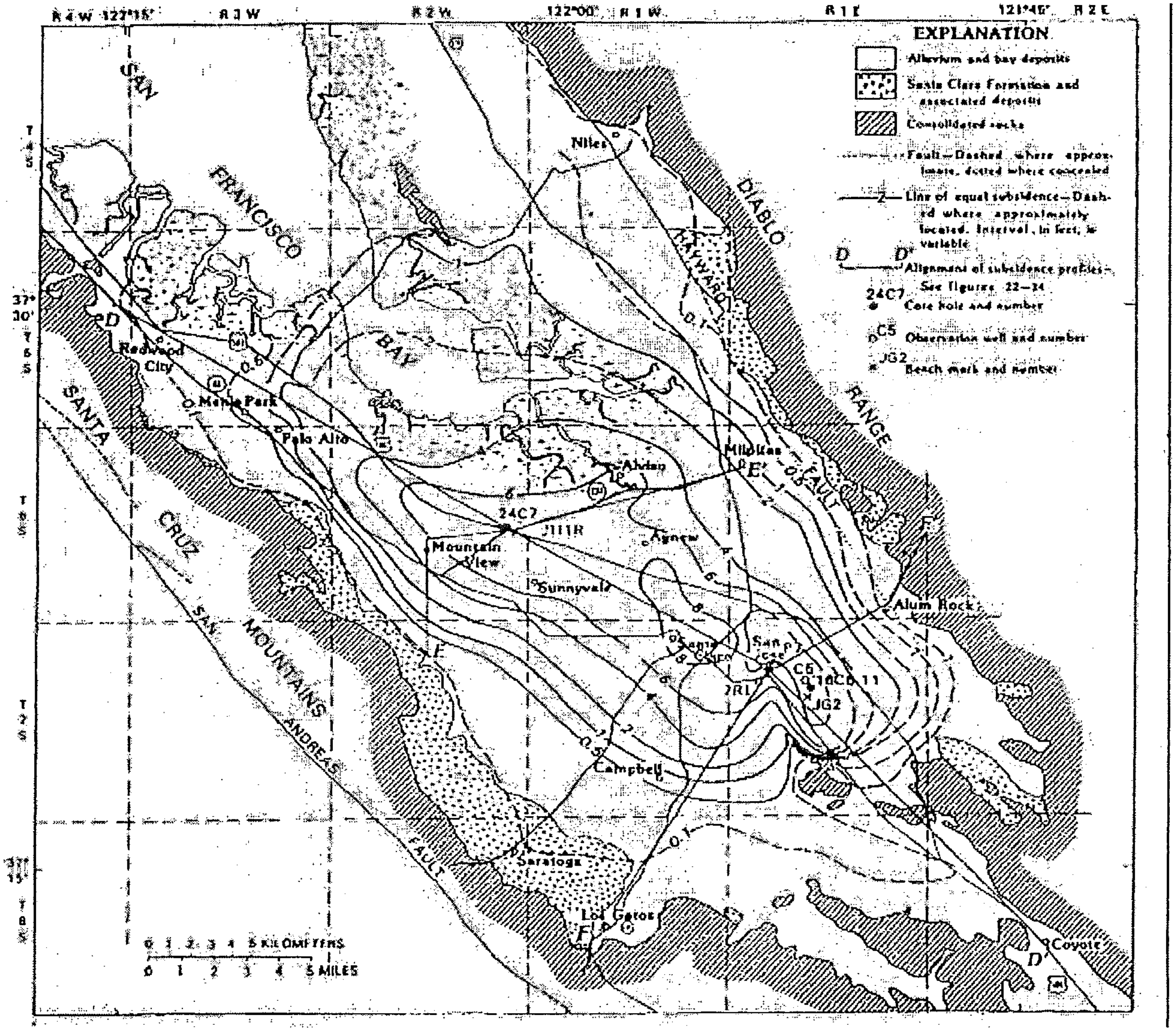
ALVISO YACHT CLUB, circa 1978. The building at the right is the same clubhouse shown above, but relocated back away from the slough in order to construct the Alviso Slough levee. The ground elevation next to the building is approximately ten (10) feet lower than the water surface in Alviso Slough on the left.

Studies of land subsidence in Santa Clara Valley indicate an average decline in ground elevation around Alviso on the order of six (6) feet between the mid-1930's to the late-1960's. A broader span of time, in this case 1914 to 1978, indicates a greater degree of subsidence on the order of ten (10) feet±. Regional subsidence has been attributed to significant groundwater pumping in the Santa Clara Valley.

From: "Flood Control in the Santa Clara Valley, An Overview," published by Santa Clara Valley Water District.

LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
TASK 10 - RECONNAISSANCE STUDY
SUBSIDENCE IMPACTS TO ALVISO, CALIFORNIA

FIGURE
3-2


R 4 W 122°15' R 3 W R 2 W 122°00' R 1 W R 1 E 121°45' R 2 E
EXPLANATION
Alluvium and bay deposits
Santa Clara Formation and associated deposits
Consolidated rocks
Fault—Dashed where approximate, dotted where concealed
Line of equal subsidence—Dashed where approximately located. Interval, in feet, is variable
D D' Alignment of subsidence profiles—See figures 22—34
24C7 Core hole and number
C5 Observation well and number
JG2 Beach mark and number
SAN FRANCISCO BAY
DIABLO RANGE
HAYWARD FAULT
SANTA CRUZ MOUNTAINS
SAN ANDREAS FAULT
Niles
Redwood City
Menlo Park
Palo Alto
Mountain View
Sunnyvale
Alviso
Milpitas
Agnew
Santa Clara
San Jose
Alum Rock
Campbell
Saratoga
Los Gatos
Coyote
24C7
J111R
C5
16C6
11
JG2
D
D'
E
E'
F
F'
0.1
0.5
0.6
1
2
4
6
8
T 4 S
37°30'
T 5 S
T 6 S
T 7 S
37°15'
T 8 S
0 1 2 3 4 5 KILOMETERS
0 1 2 3 4 5 MILES

From Poland and Ireland, 1988.

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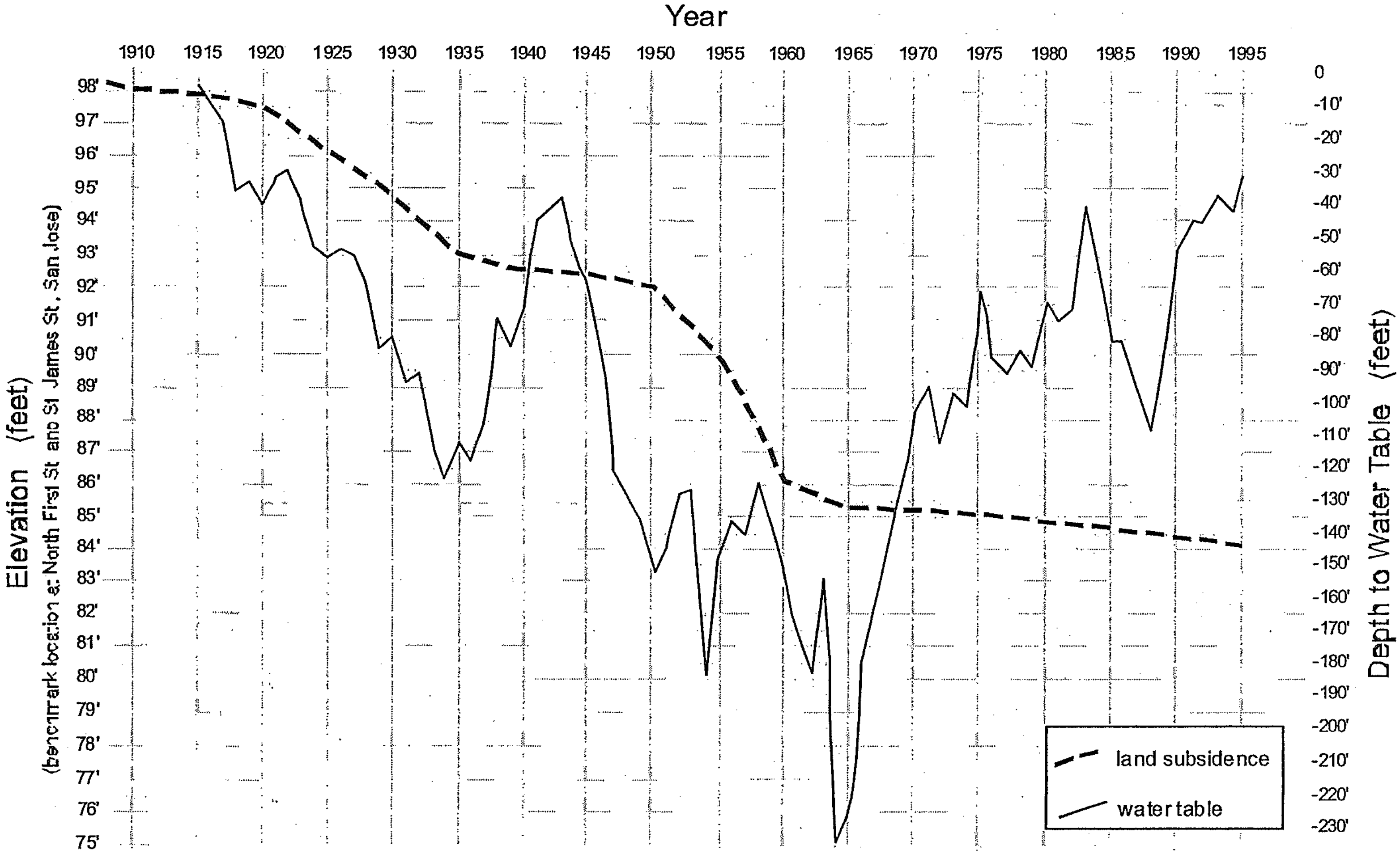
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
TASK 10 – RECONNAISSANCE STUDY
LAND SUBSIDENCE FROM 1934 TO 1967

FIGURE
3-3



Land Subsidence and Depth to Water Table, San Jose, California (1906 - 1995) (from: SCVWD, 1995).

---

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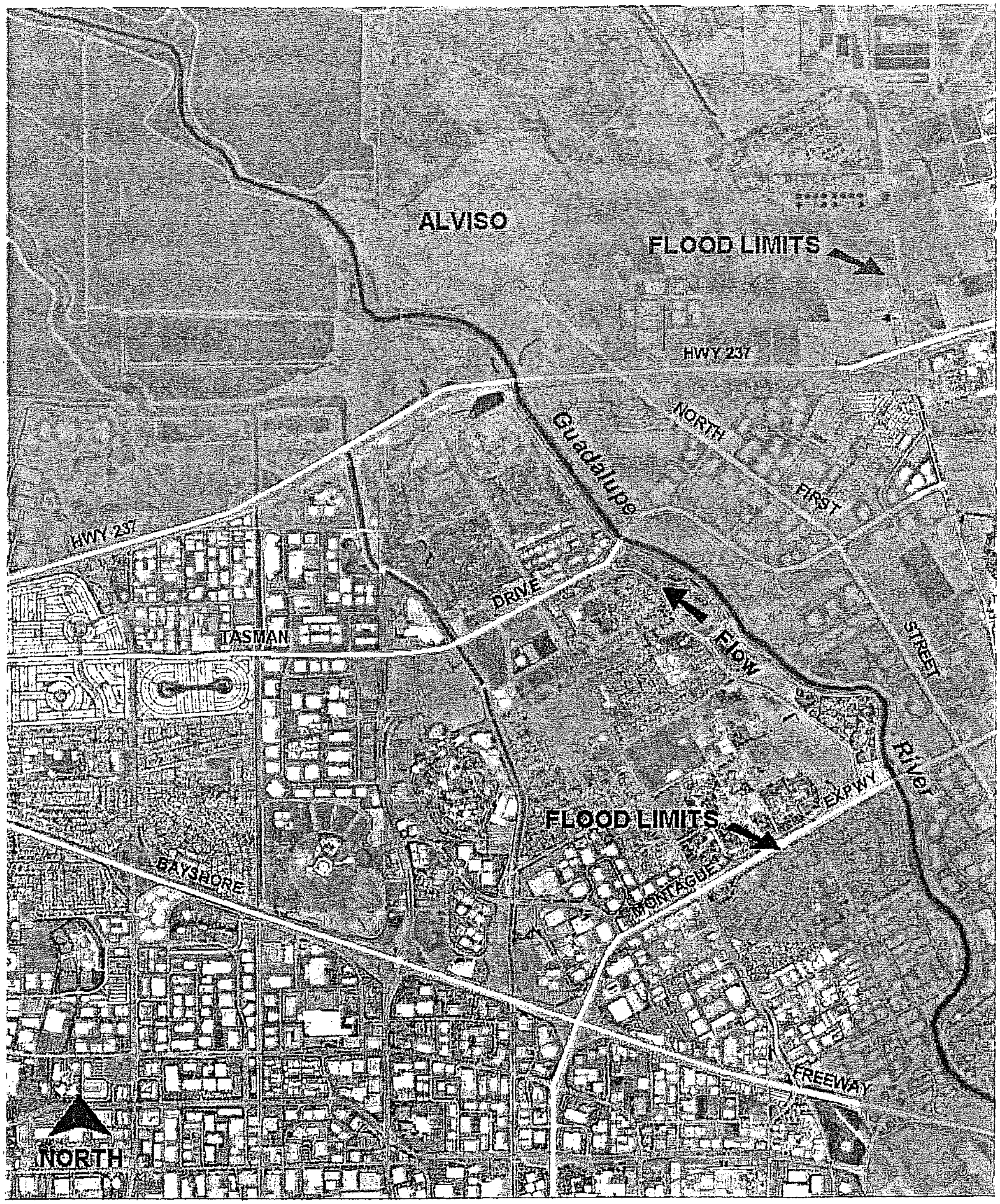
**LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY
LAND SUBSIDENCE AND WATER TABLE TREND**

FIGURE
3-4



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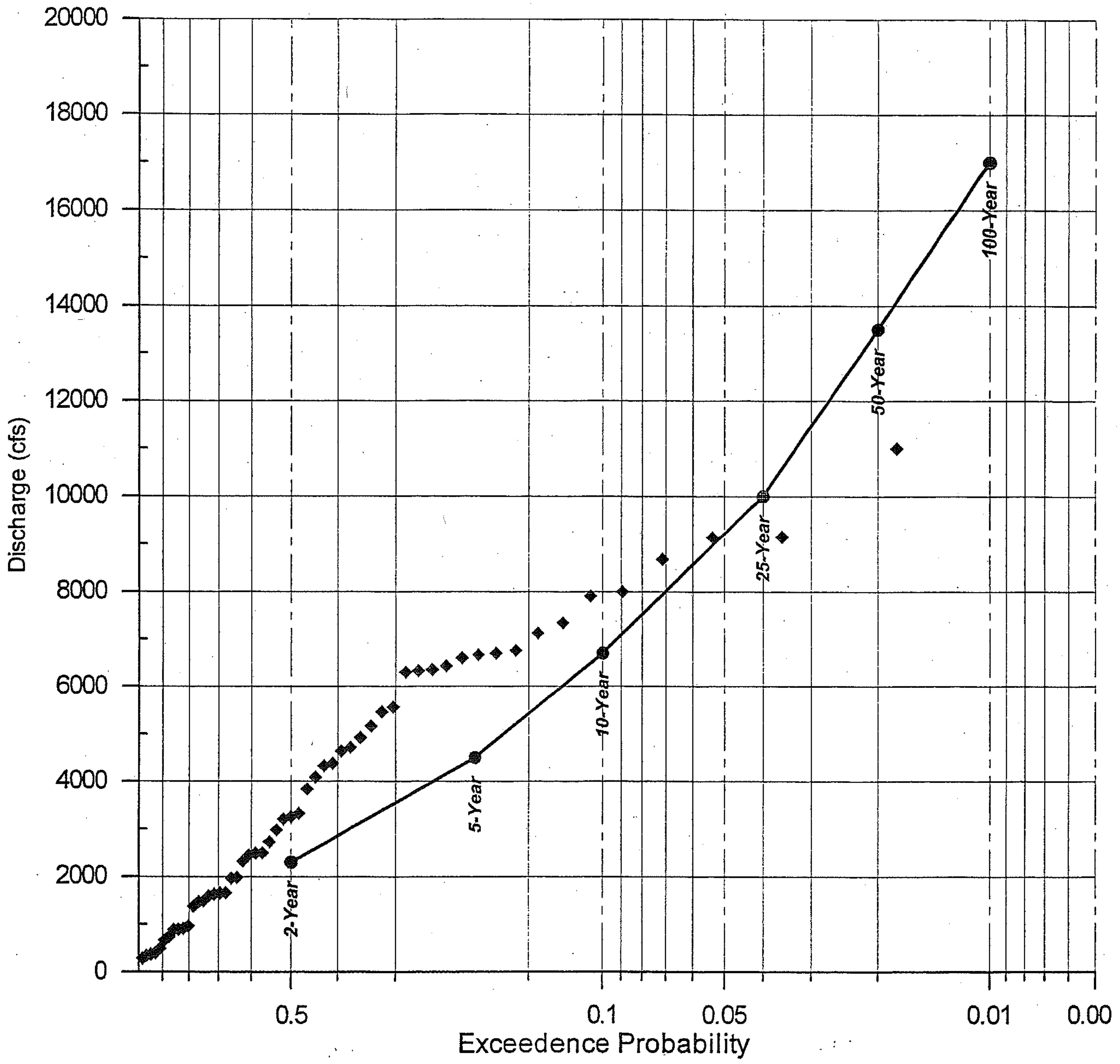
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
LOWER GUADALUPE RIVER NEAR ALVISO, CALIFORNIA
ESTIMATED EXTENT OF BASE FLOOD

FIGURE
3-5

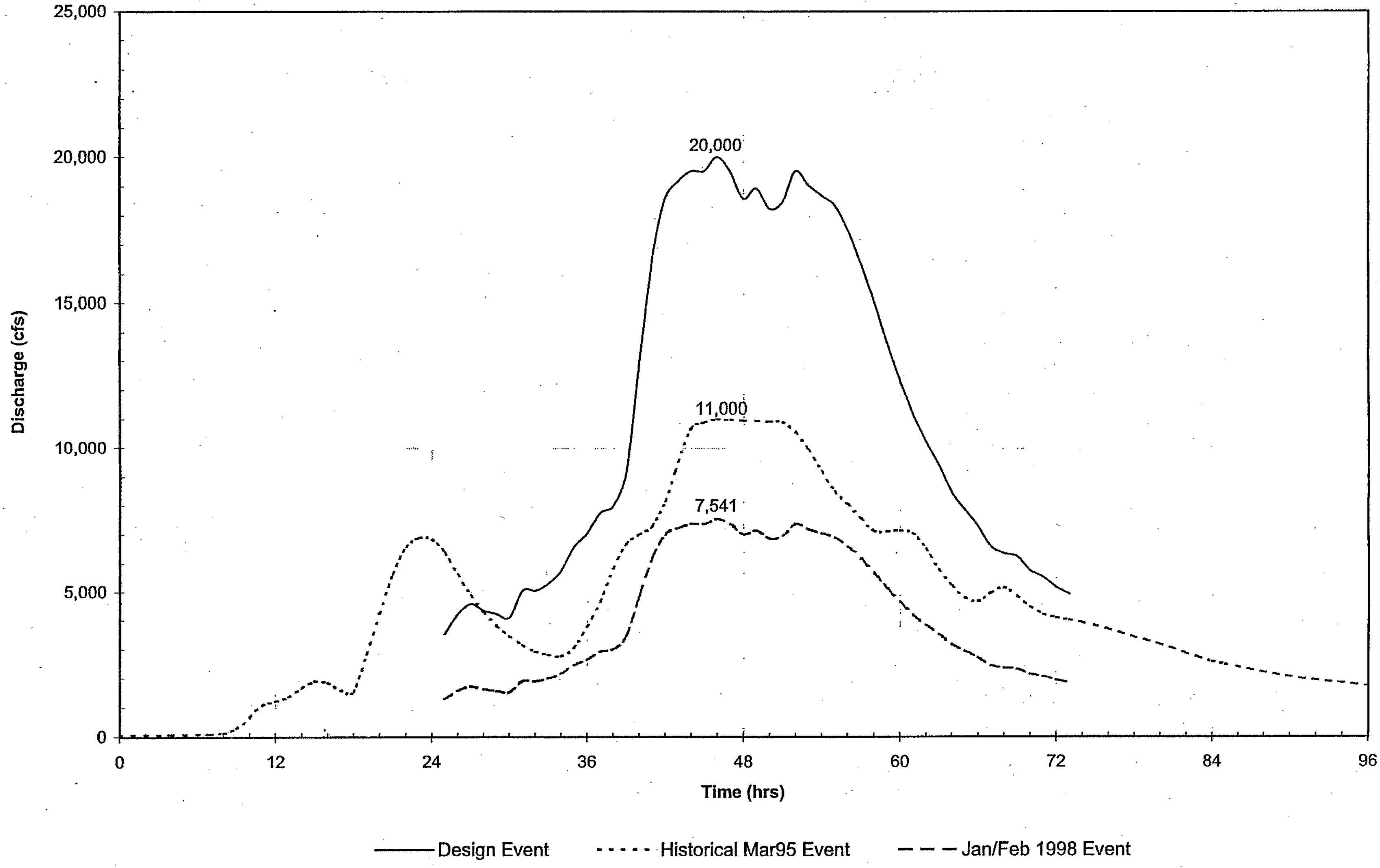


LEGEND

◆ Historical Peak Annual Flows

—●— COE 1993 Flow-Frequency Curve

FIGURE 4-1



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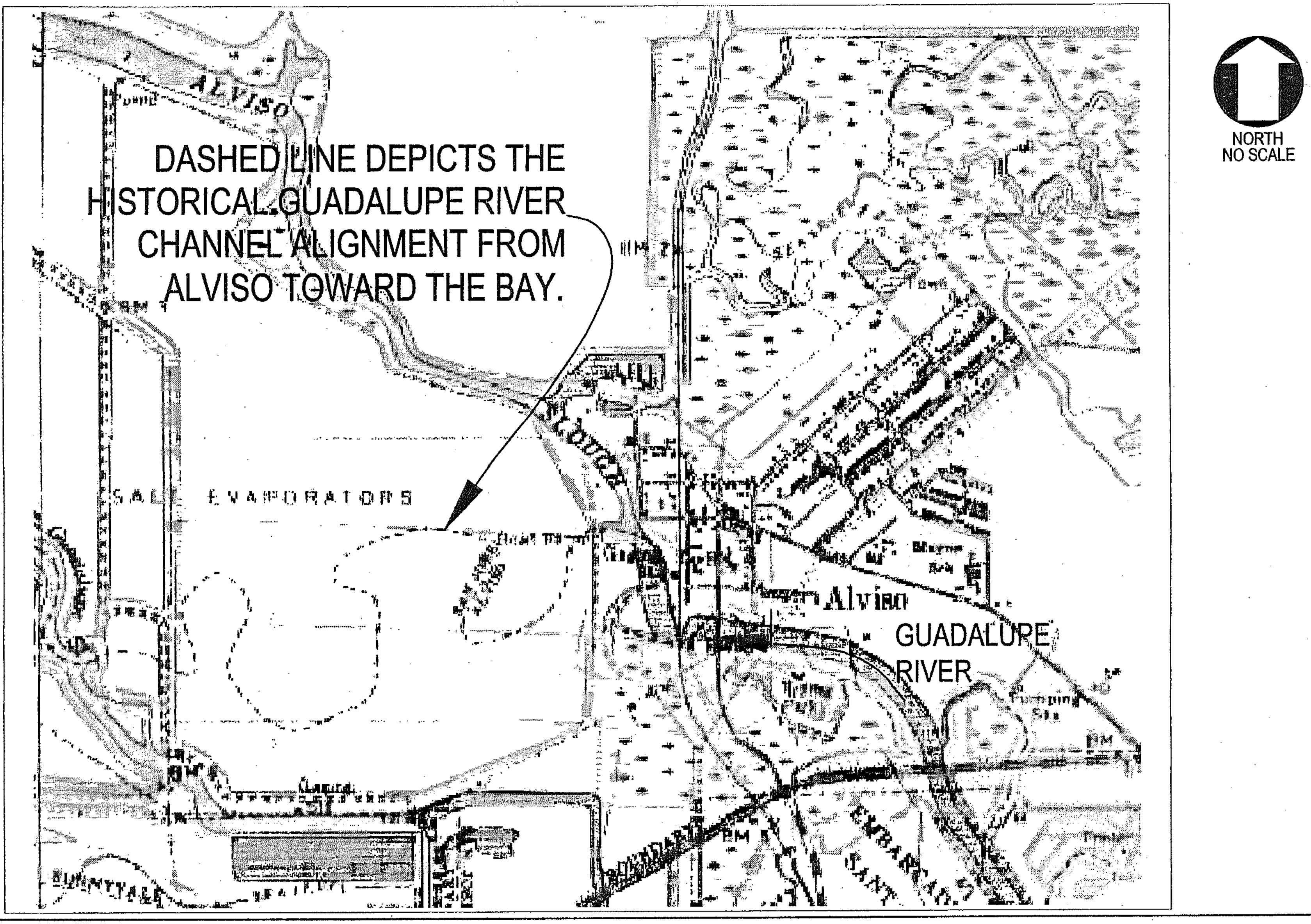
UNET MODELING
HYDRAULIC BOUNDARY CONDITIONS
GUADALUPE RIVER/ALVISO SLOUGH

FIGURE
4-2



DASHED LINE DEPICTS THE HISTORICAL GUADALUPE RIVER CHANNEL ALIGNMENT FROM ALVISO TOWARD THE BAY.

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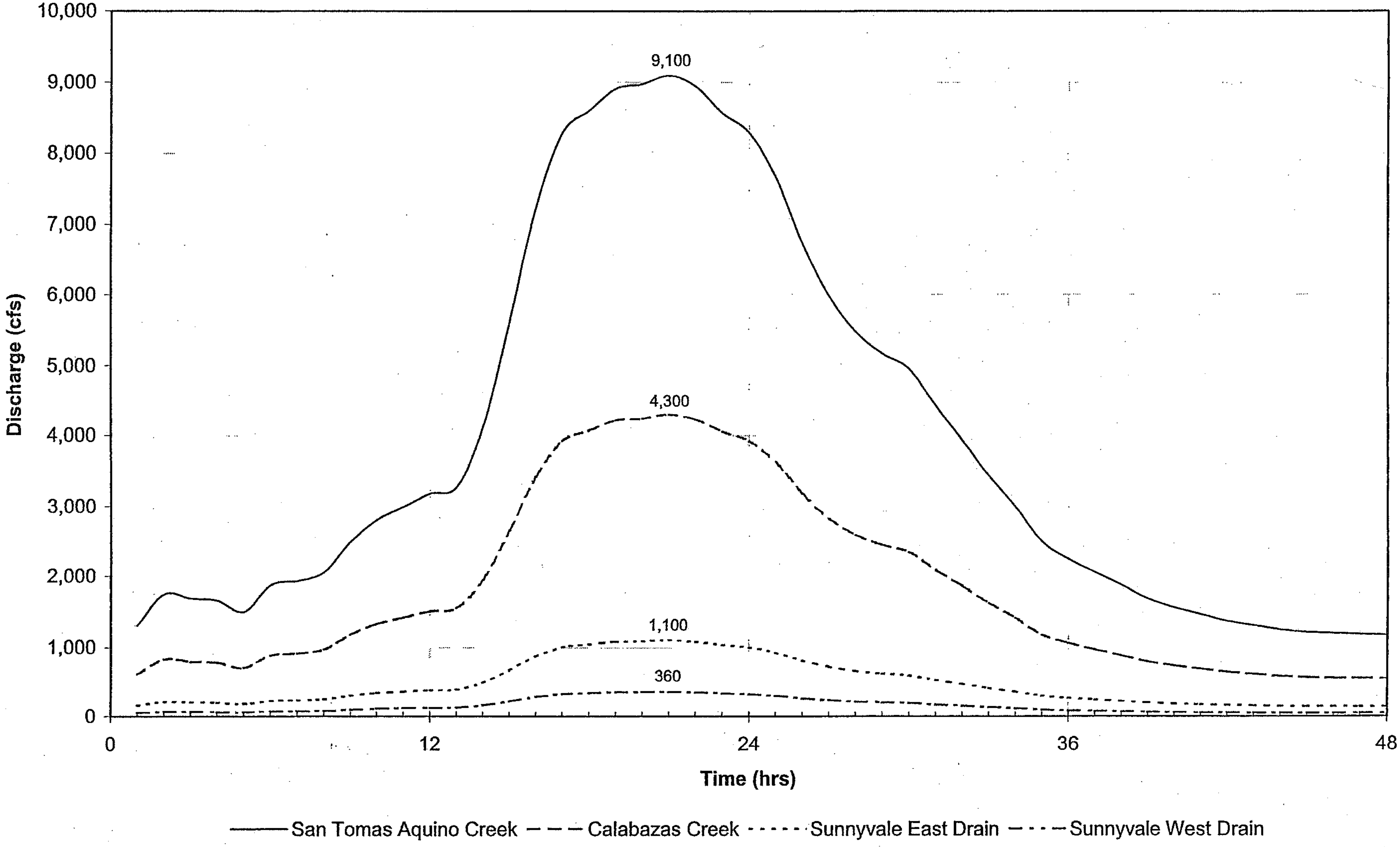
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
TASK 10 - RECONNAISSANCE STUDY
HISTORICAL GUADALUPE RIVER CHANNEL ALIGNMENT

FIGURE
4-3



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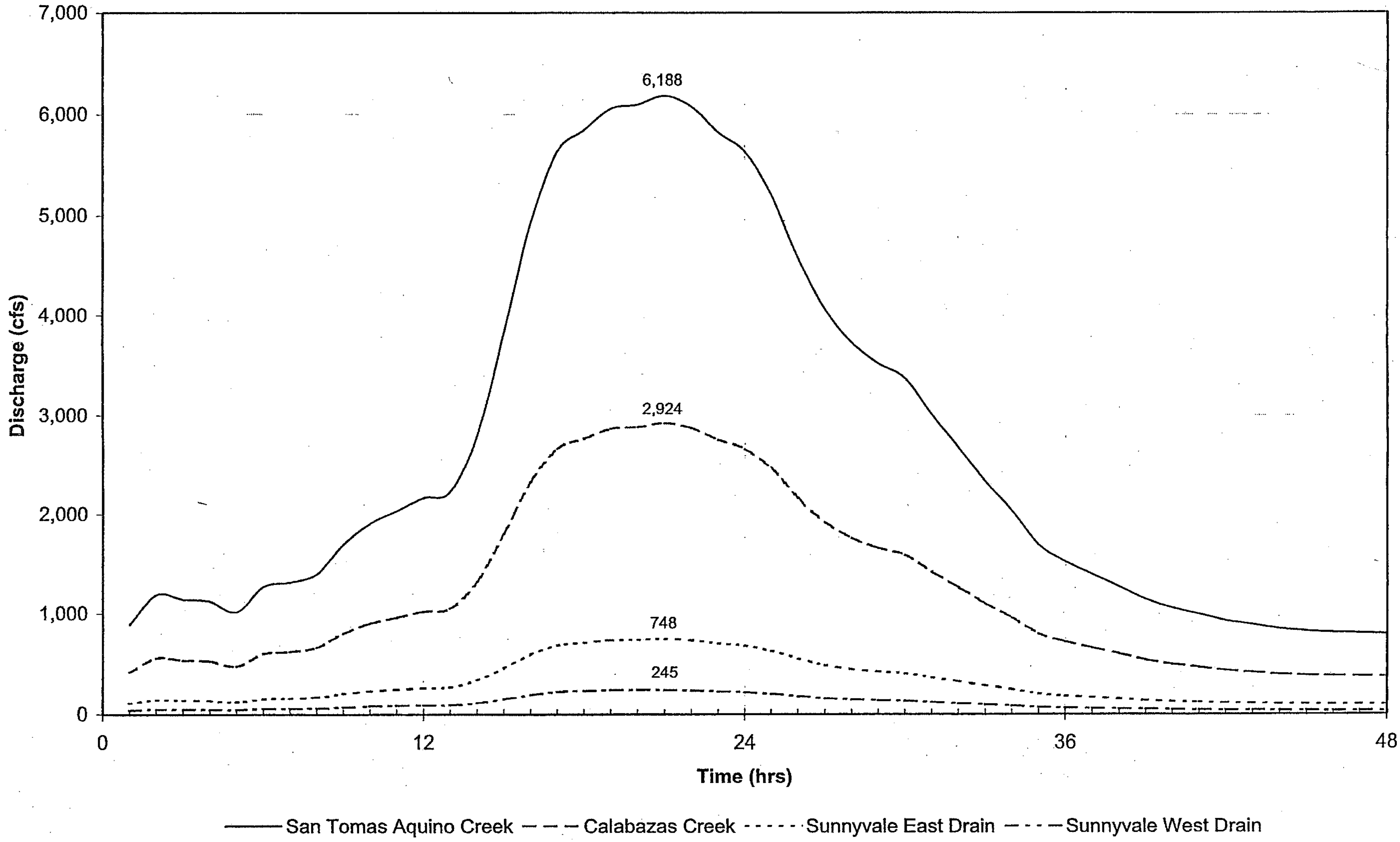
UNET MODELING
HYDRAULIC BOUNDARY CONDITIONS
GUADALUPE SLOUGH DESIGN EVENT

FIGURE
4-4



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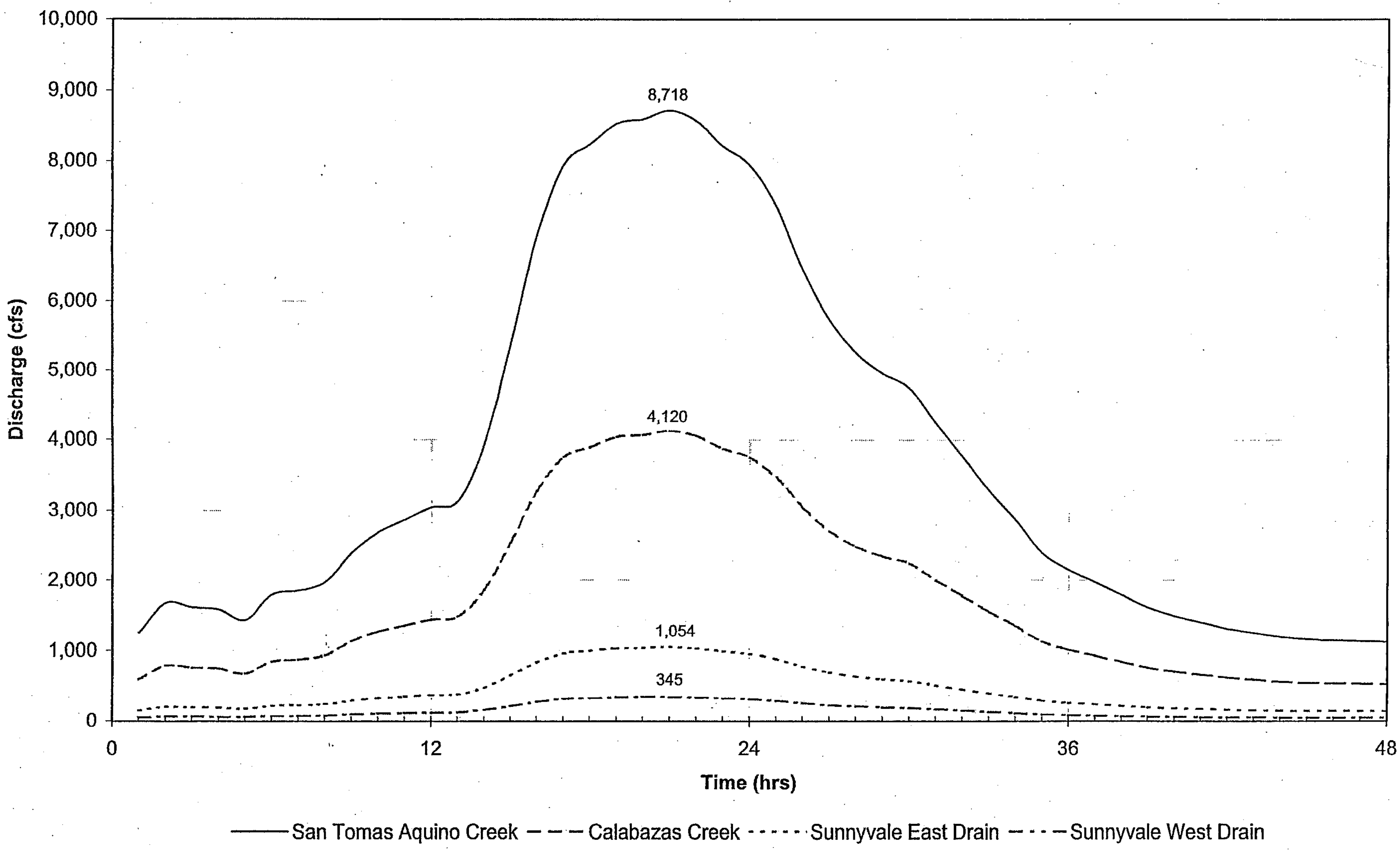
UNET MODELING
HYDRAULIC BOUNDARY CONDITIONS
GUADALUPE SLOUGH MARCH 1995 EVENT

FIGURE
4-5



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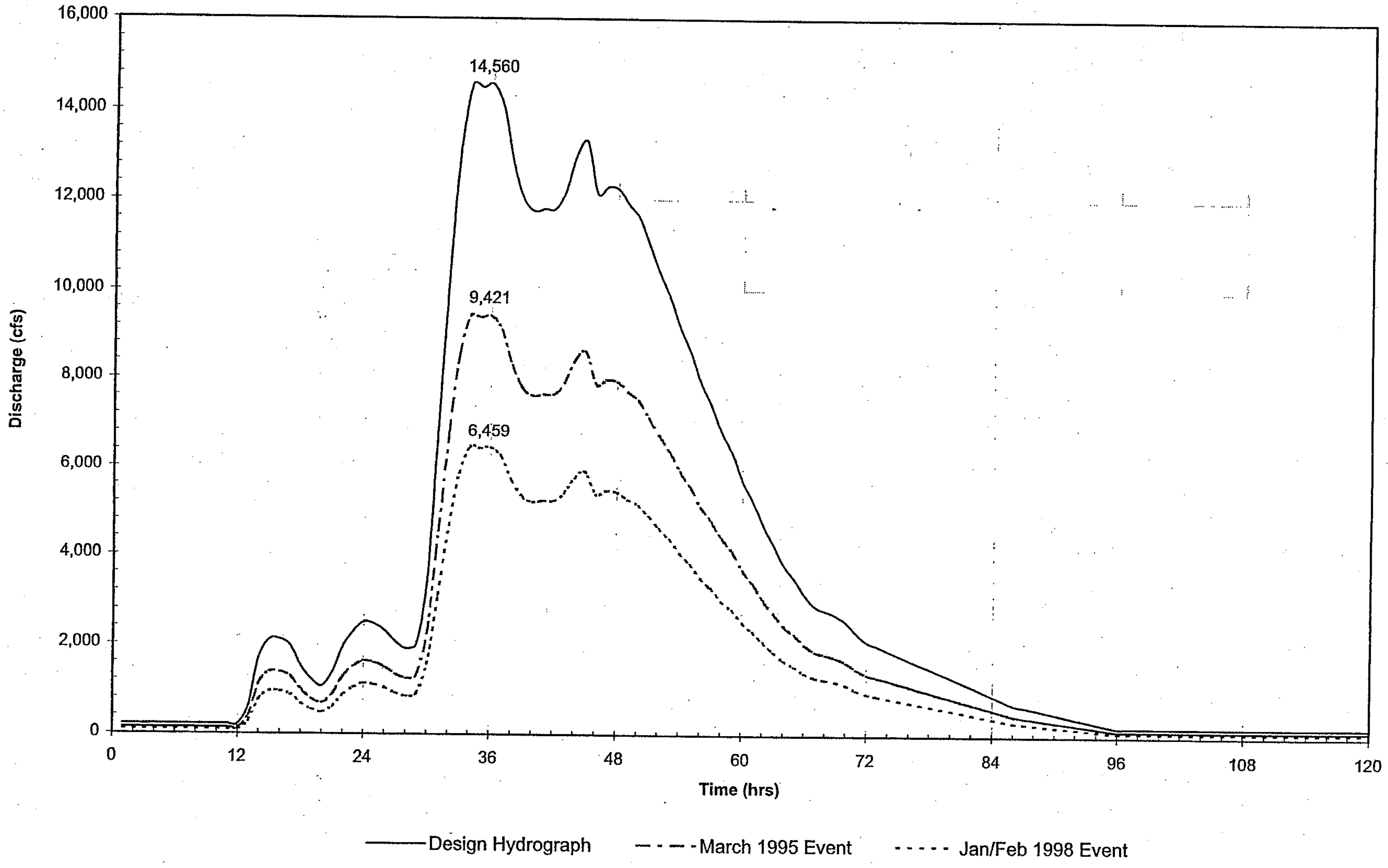
UNET MODELING
HYDRAULIC BOUNDARY CONDITIONS
GUADALUPE SLOUGH FEBRUARY 1998 EVENT

FIGURE
4-6



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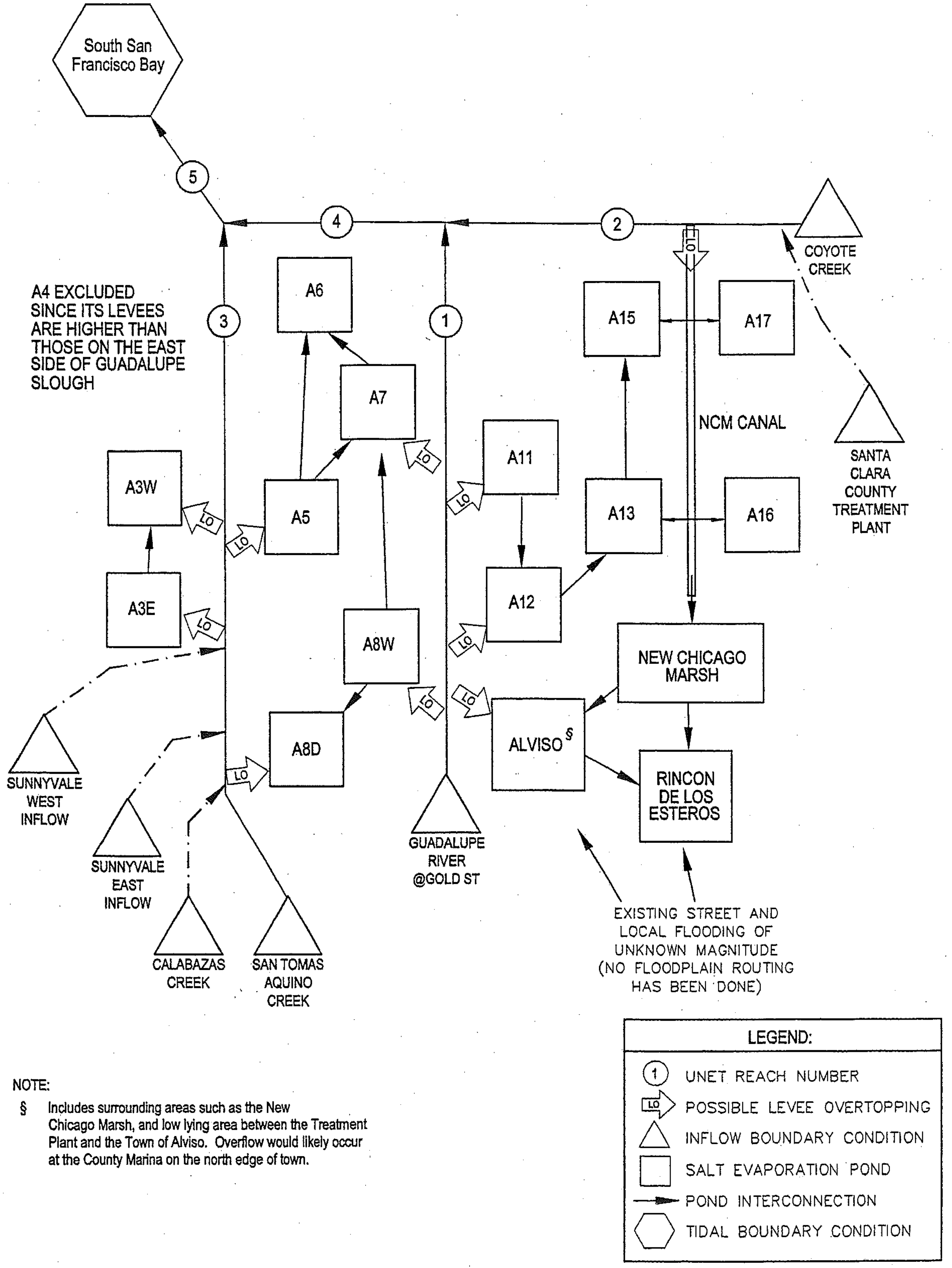
UNET MODELING
HYDRAULIC BOUNDARY CONDITIONS
COYOTE CREEK

FIGURE
4-7



A4 EXCLUDED SINCE ITS LEVEES ARE HIGHER THAN THOSE ON THE EAST SIDE OF GUADALUPE SLOUGH

EXISTING STREET AND LOCAL FLOODING OF UNKNOWN MAGNITUDE (NO FLOODPLAIN ROUTING HAS BEEN DONE)

NOTE:

§ Includes surrounding areas such as the New Chicago Marsh, and low lying area between the Treatment Plant and the Town of Alviso. Overflow would likely occur at the County Marina on the north edge of town.

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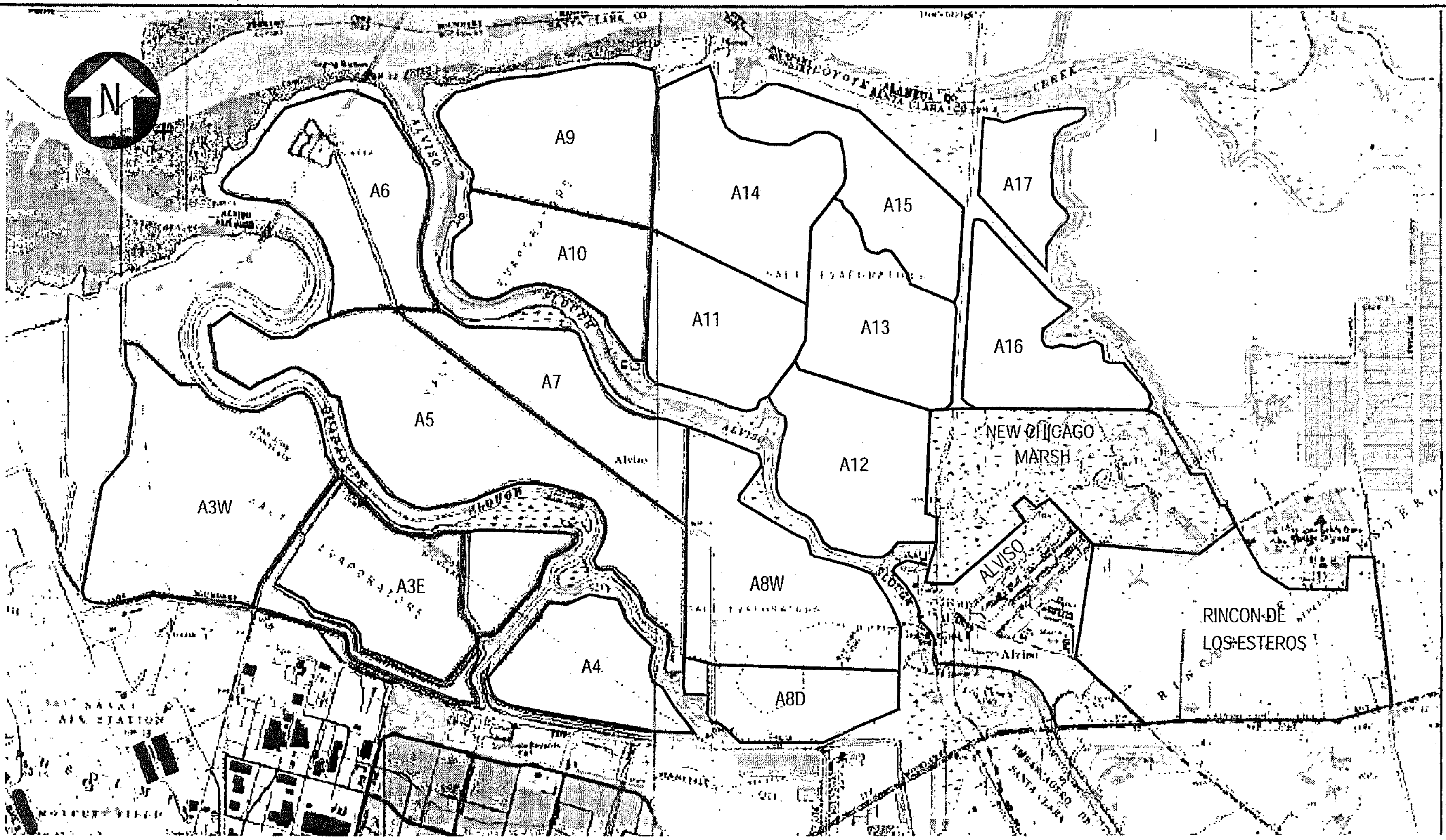
LOWER GUADALUPE RIVER FLOOD CONTROL PROJECT
DYNAMIC MODEL SCHEMATIC
RECONNAISSANCE STUDY AREA

FIGURE
4-8



LEGEND

A7 CARGILL EVAPORATOR POND NO.

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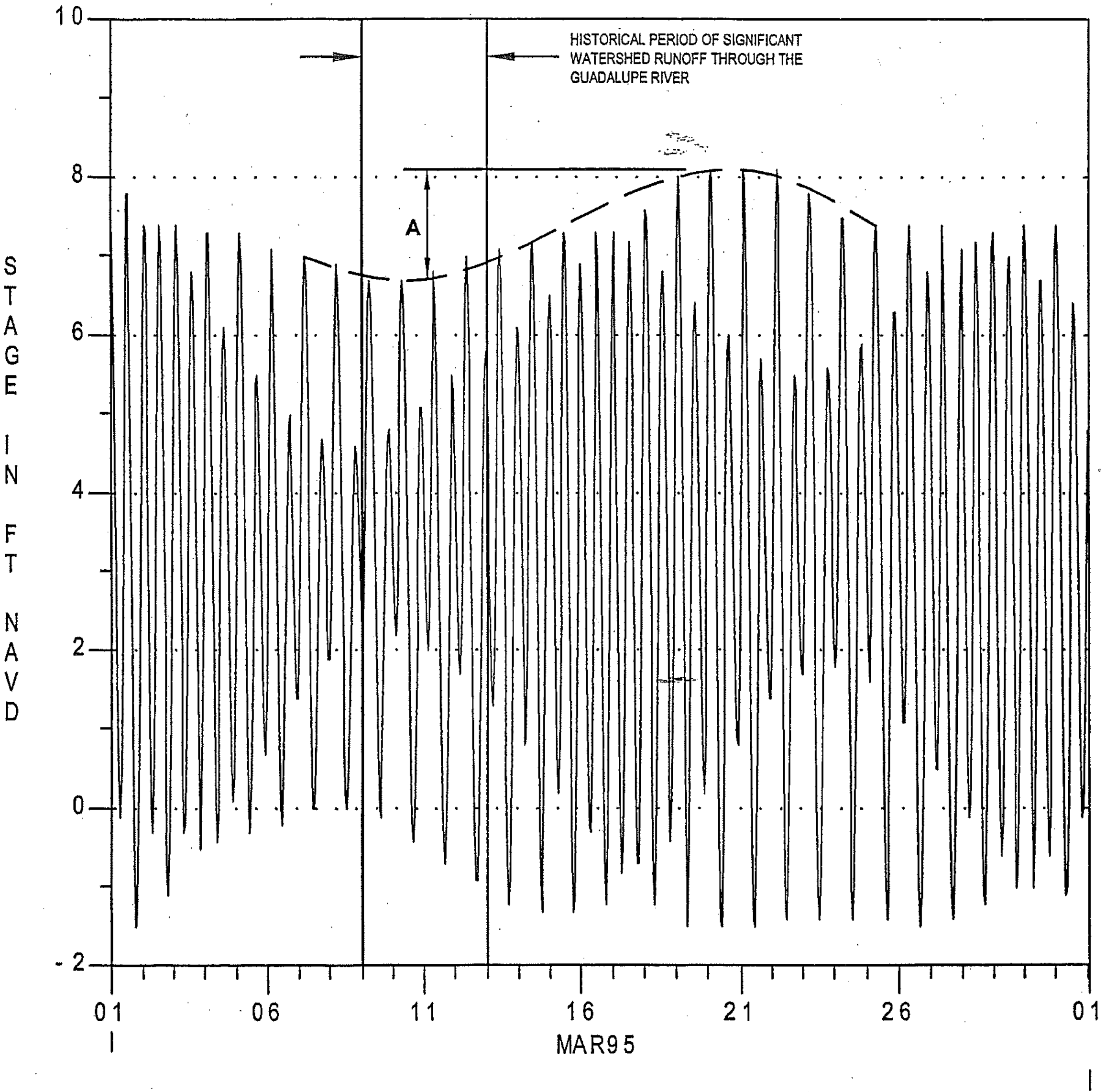
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY
DELINEATED UNET MODEL STORAGE CELLS

FIGURE
4-9

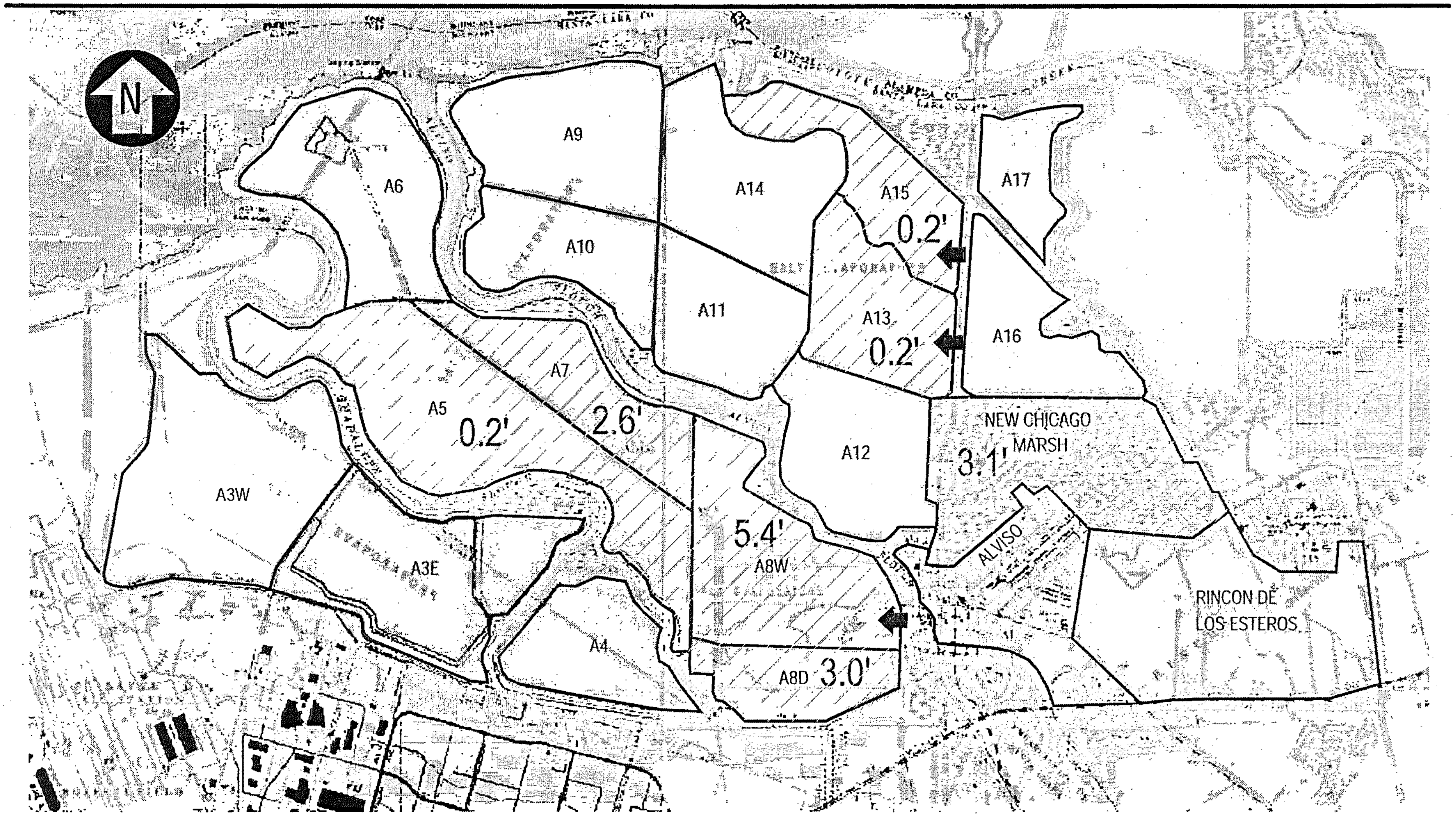


NOTE:

A. Downstream hydraulic boundary conditions during the March 1995 storm was near/at a "neap" tide condition. Potential exists for downstream hydraulic condition to be 1'+ higher in stage.

LGRFPP TASK 10 - RECONNAISSANCE STUDY ALVISO SLOUGH TIDE CONDITIONS DURING GUADALUPE RIVER MARCH 1995 FLOOD

FIGURE 4-10



LEGEND

A7	CARGILL EVAPORATOR POND NO.
3.1'	DEPTH OF INUNDATION (IN FEET)
⬅	LEVEE OVERTOPPING

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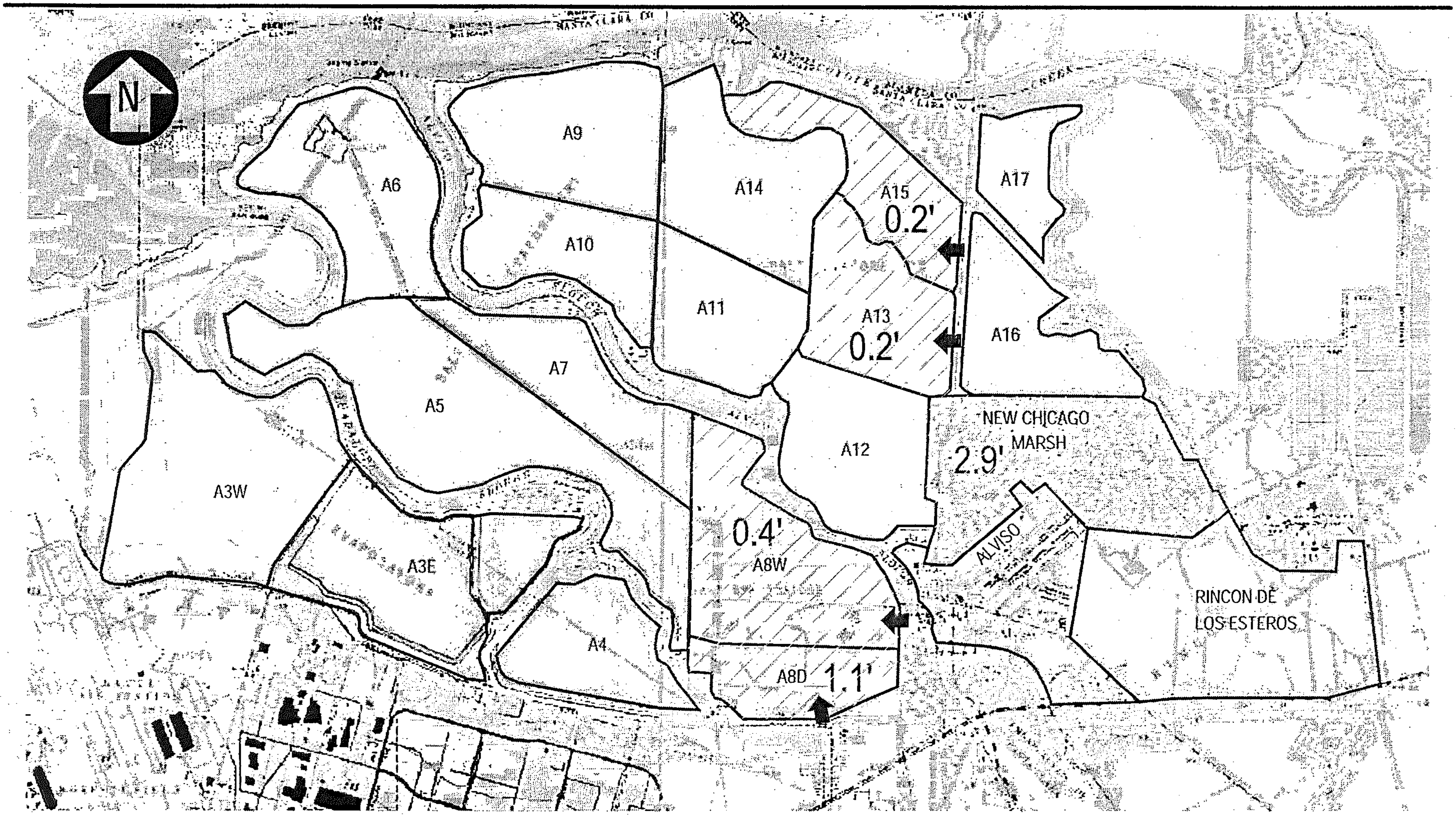
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY
MARCH 1995 UNET RESULTS

FIGURE
4-11



LEGEND

A7 CARGILL EVAPORATOR POND NO.

1.1' DEPTH OF INUNDATION (IN FEET)

🡄 LEVEE OVERTOPPING

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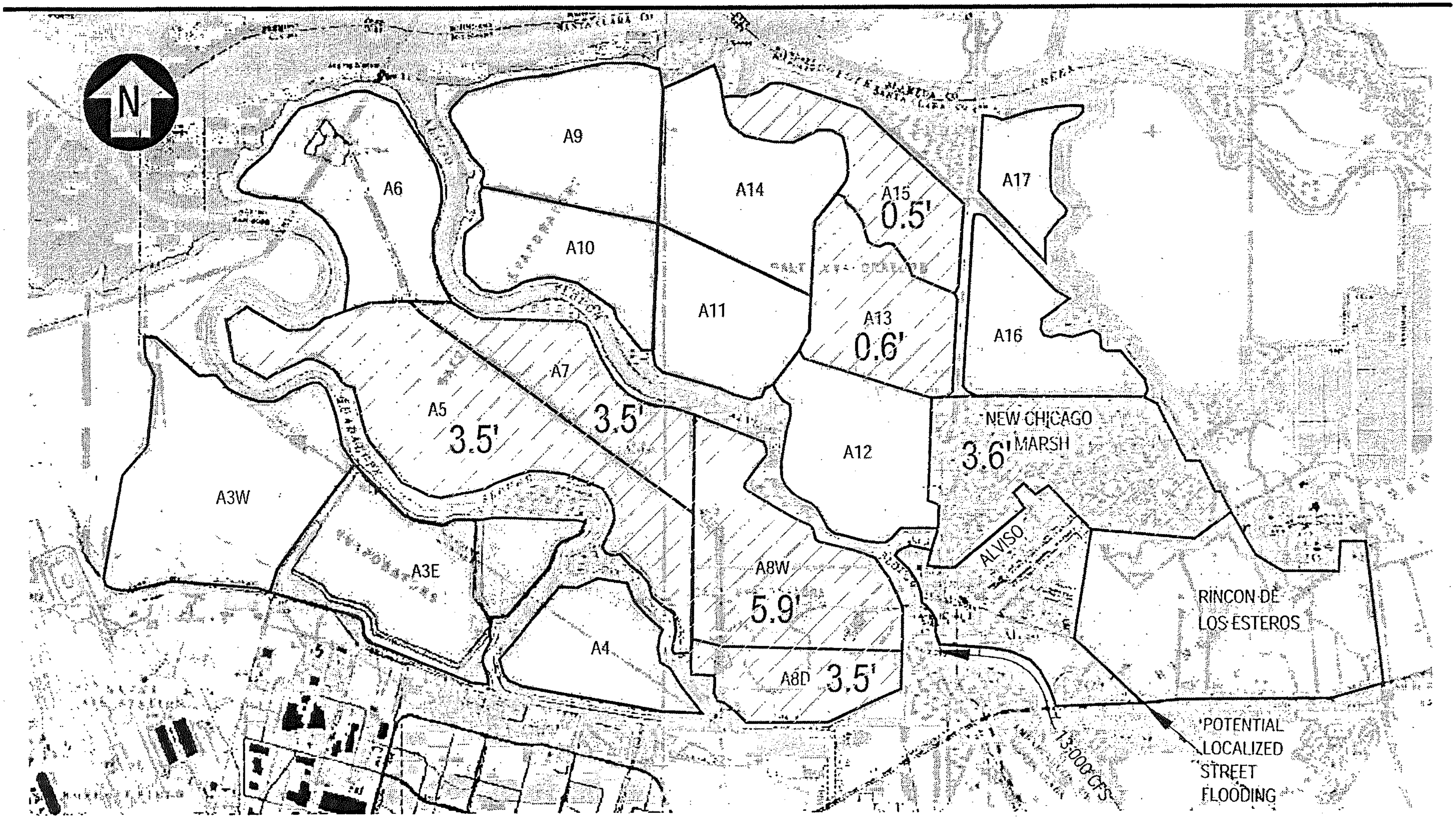
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY
FEBRUARY 1998 UNET RESULTS

FIGURE 4-12



LEGEND

A7 CARGILL EVAPORATOR POND NO.

3.5' DEPTH OF INUNDATION (IN FEET)

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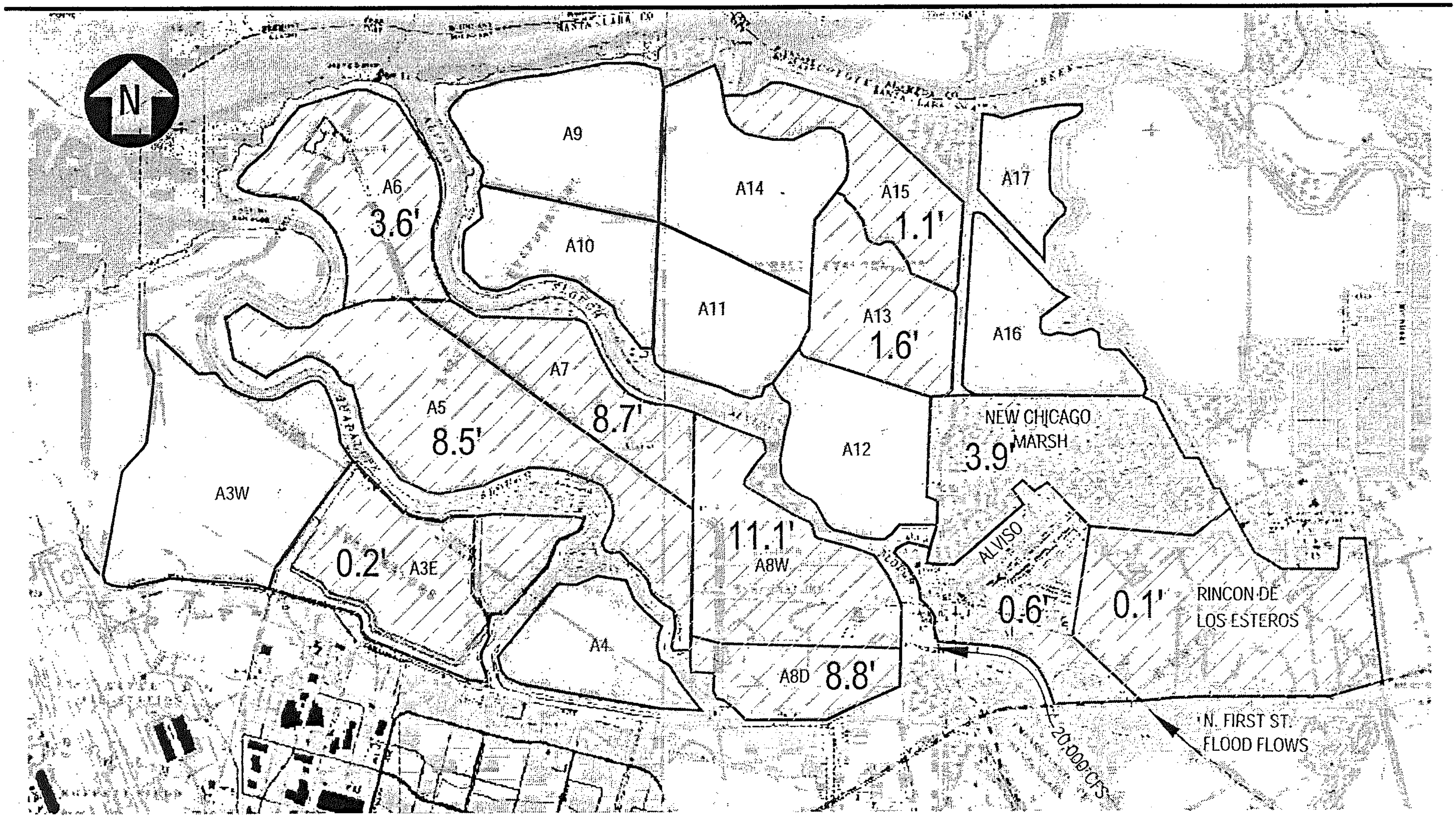
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY
BASELINE CONDITIONS (TODAY) WITH 13,000 CFS

FIGURE
4-13



LEGEND

A7	CARGILL EVAPORATOR POND NO.
3.9'	DEPTH OF INUNDATION (IN FEET)

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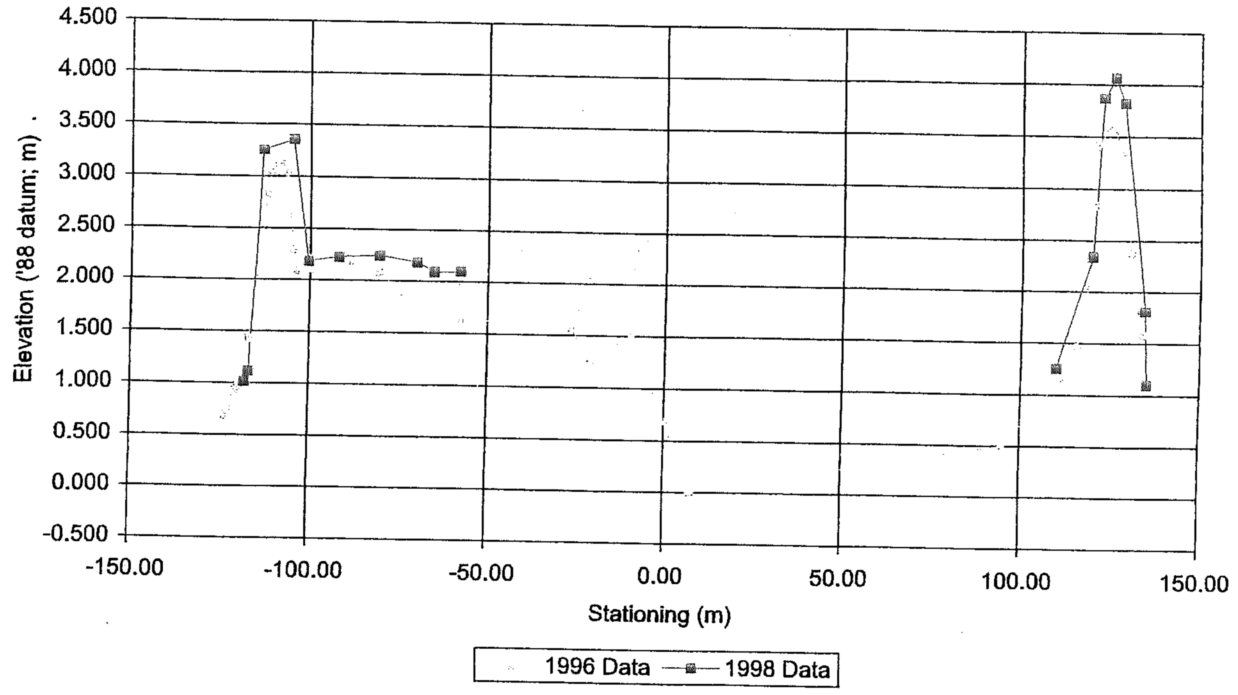
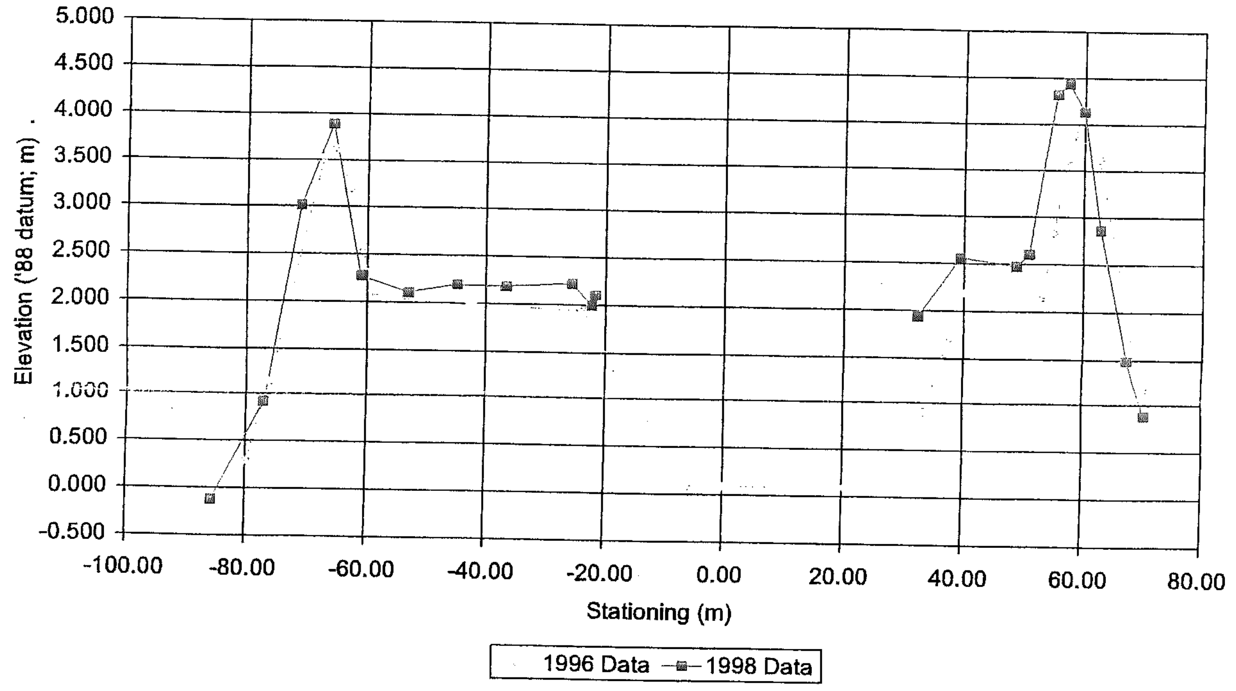
LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
RECONNAISSANCE STUDY - UPRR TO THE BAY
BASELINE CONDITIONS (TODAY) WITH DESIGN EVENT

FIGURE
4-14

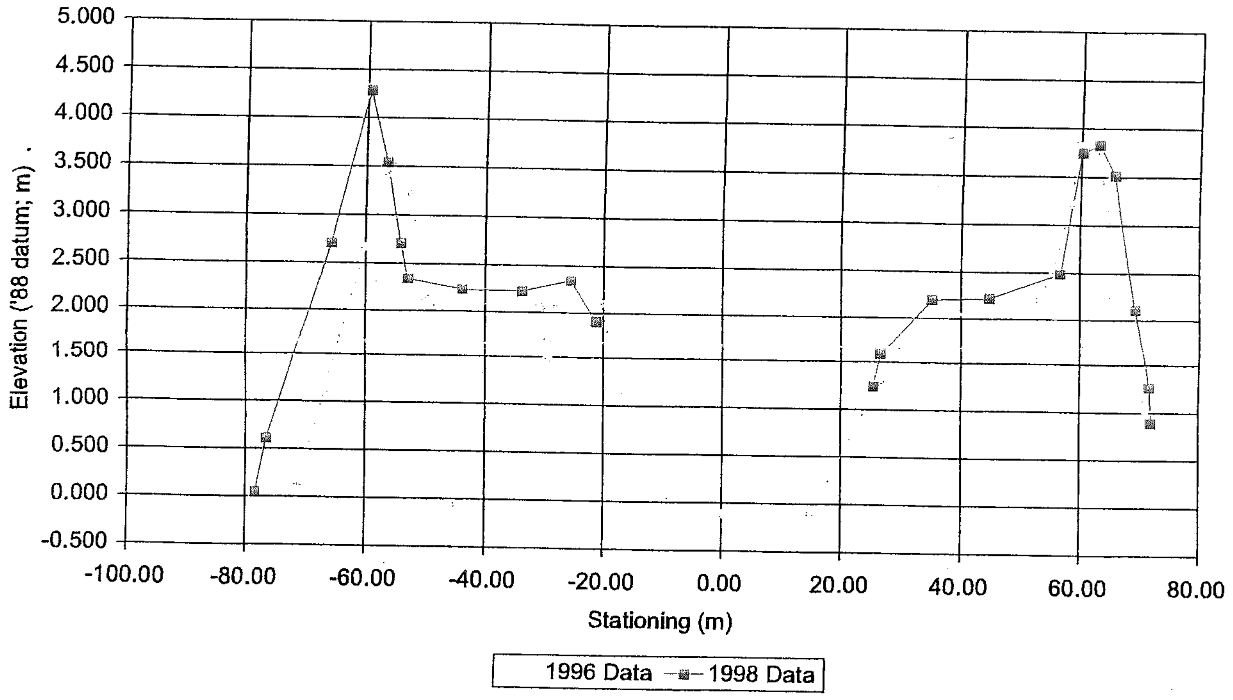
Alviso Slough Section Comparison
Cross Section 0+660



Alviso Slough Section Comparison
Cross Section4+860



Alviso Slough Section Comparison
Cross Section 5+460



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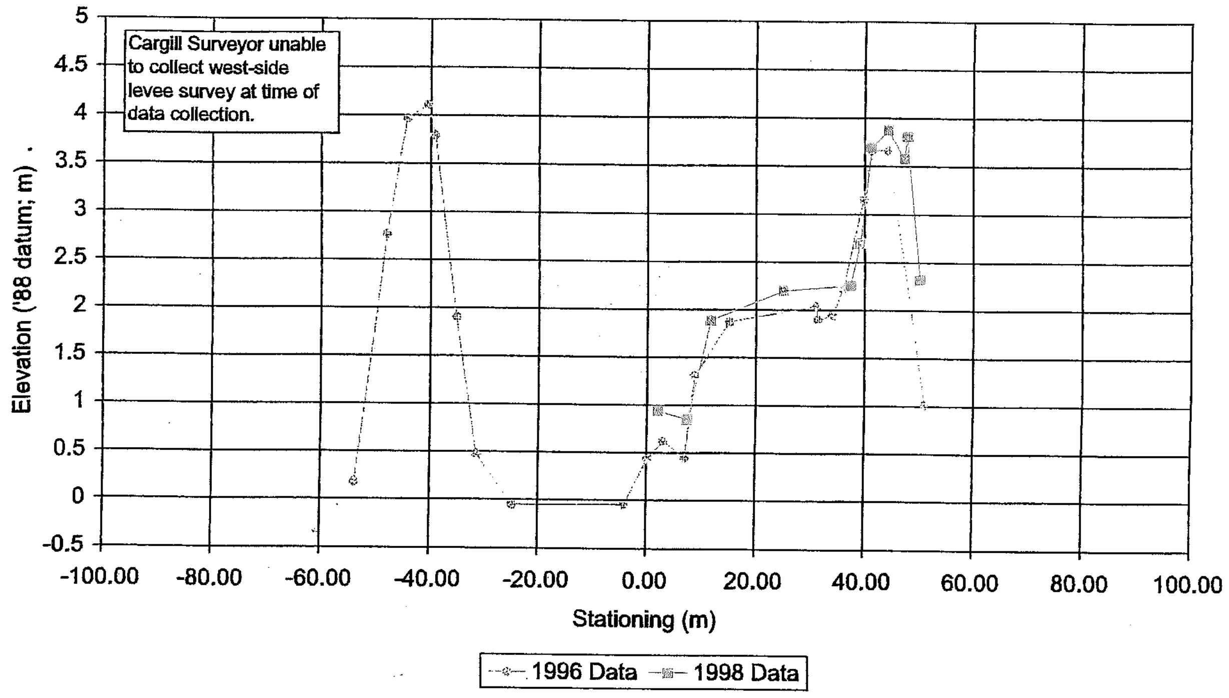
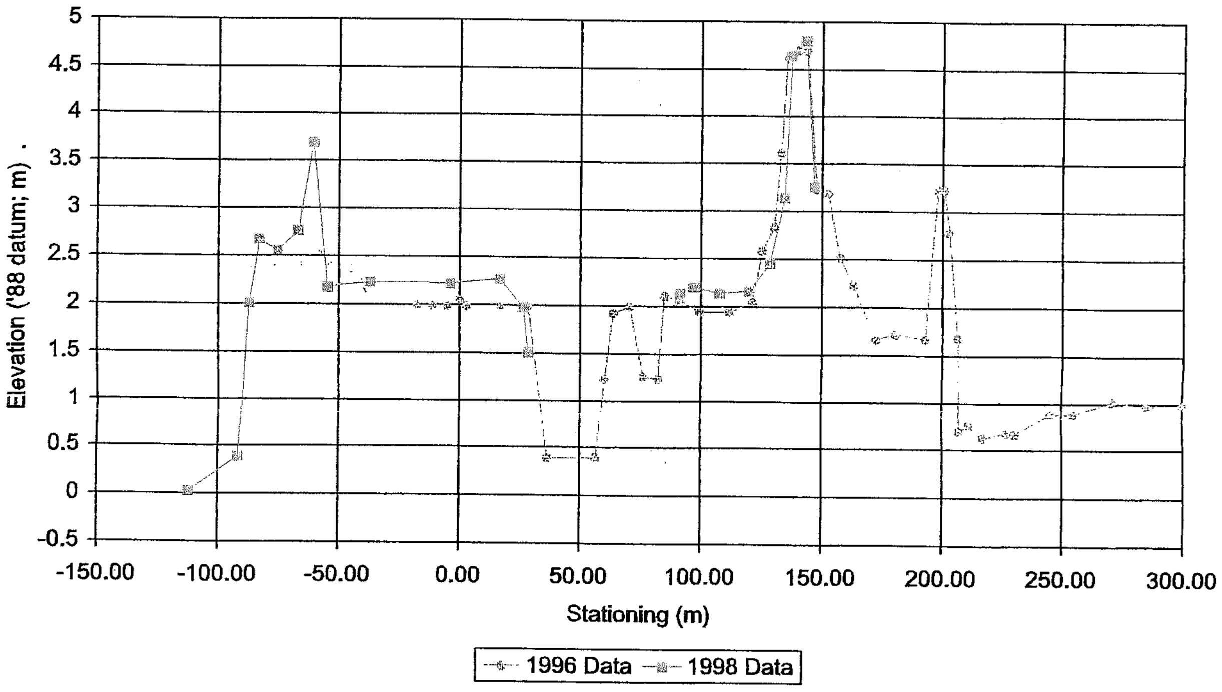
LOWER GUADALUPE RIVER FLOOD PROECTION PROJECT
TASK 10 – RECONNAISSANCE STUDY
ALVISO SLOUGH CROSS-SECTION COMPARISONS, 1996 –1998

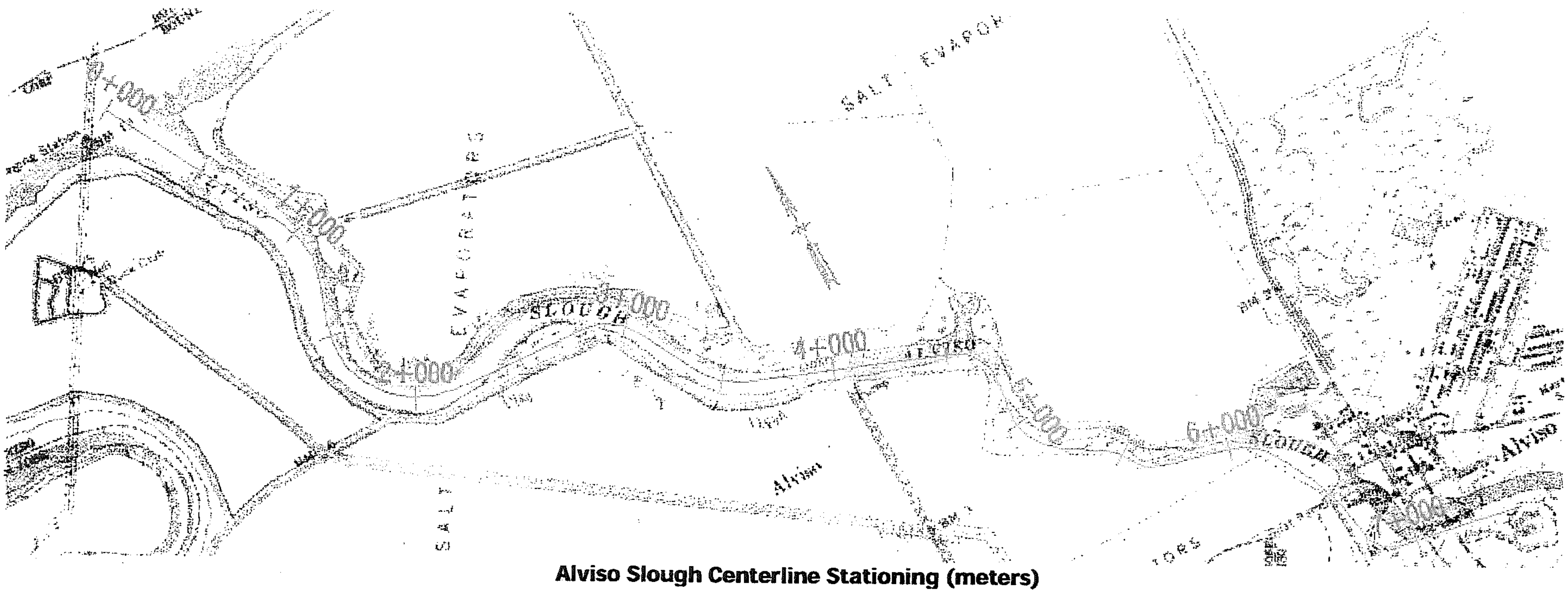
FIGURE
4-15



Alviso Slough Section Comparison
Cross Section 5+820



Alviso Slough Section Comparison
Cross Section 6+600



Alviso Slough Centerline Stationing (meters)

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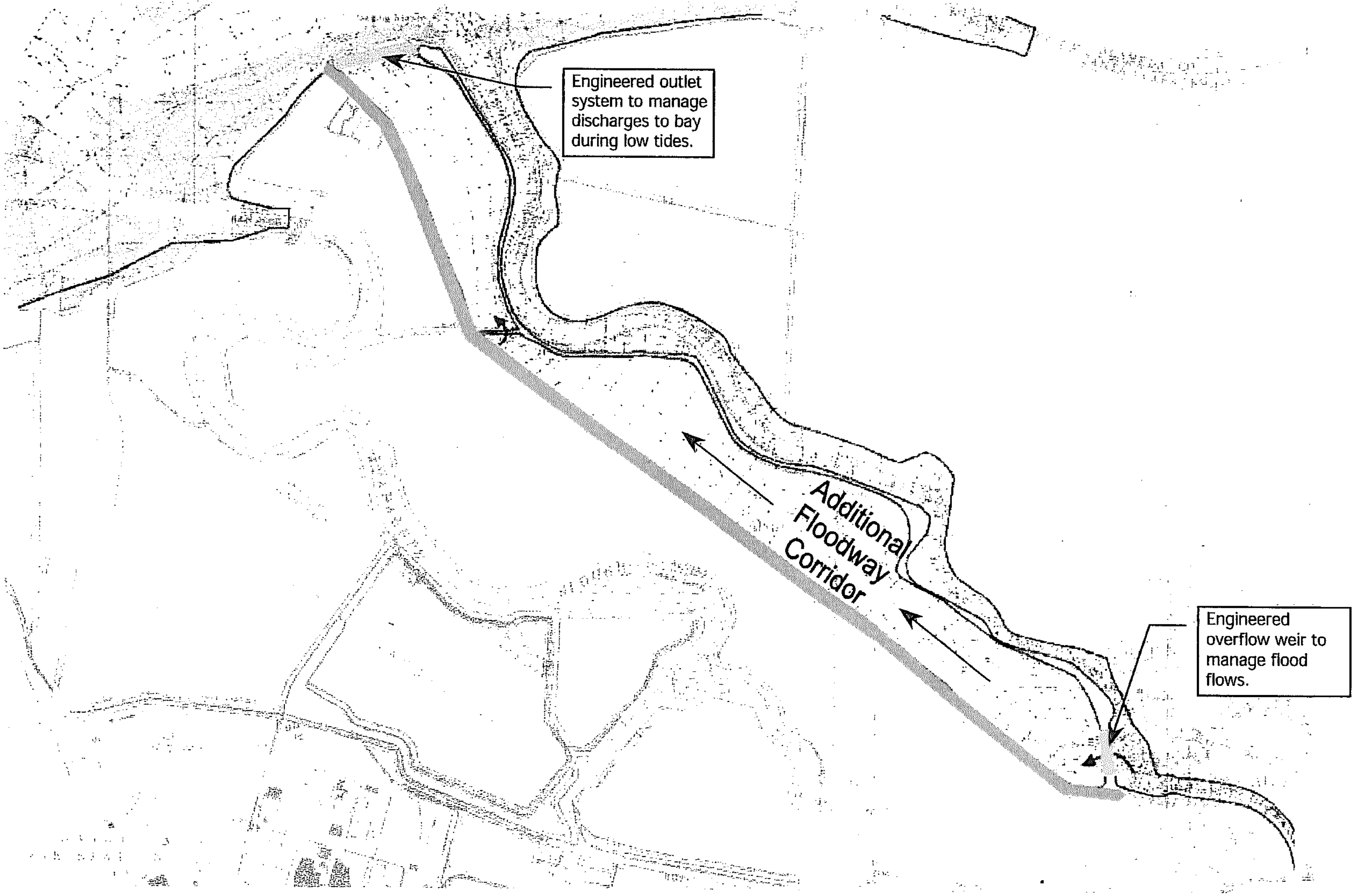
LOWER GUADALUPE RIVER FLOOD PROECTION PROJECT
TASK 10 – RECONNAISSANCE STUDY
ALVISO SLOUGH CROSS-SECTION COMPARISONS, 1996 –1998

FIGURE
4-16


Engineered outlet system to manage discharges to bay during low tides.
Additional Floodway Corridor
Engineered overflow weir to manage flood flows.

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LOWER GUADALUPE RIVER FLOOD PROTECTION PROJECT
TASK 10 – RECONNAISSANCE STUDY
ALVISO SLOUGH SETBACK LEVEE AND FLOODWAY CORRIDOR

FIGURE 4-17

APPENDIX A

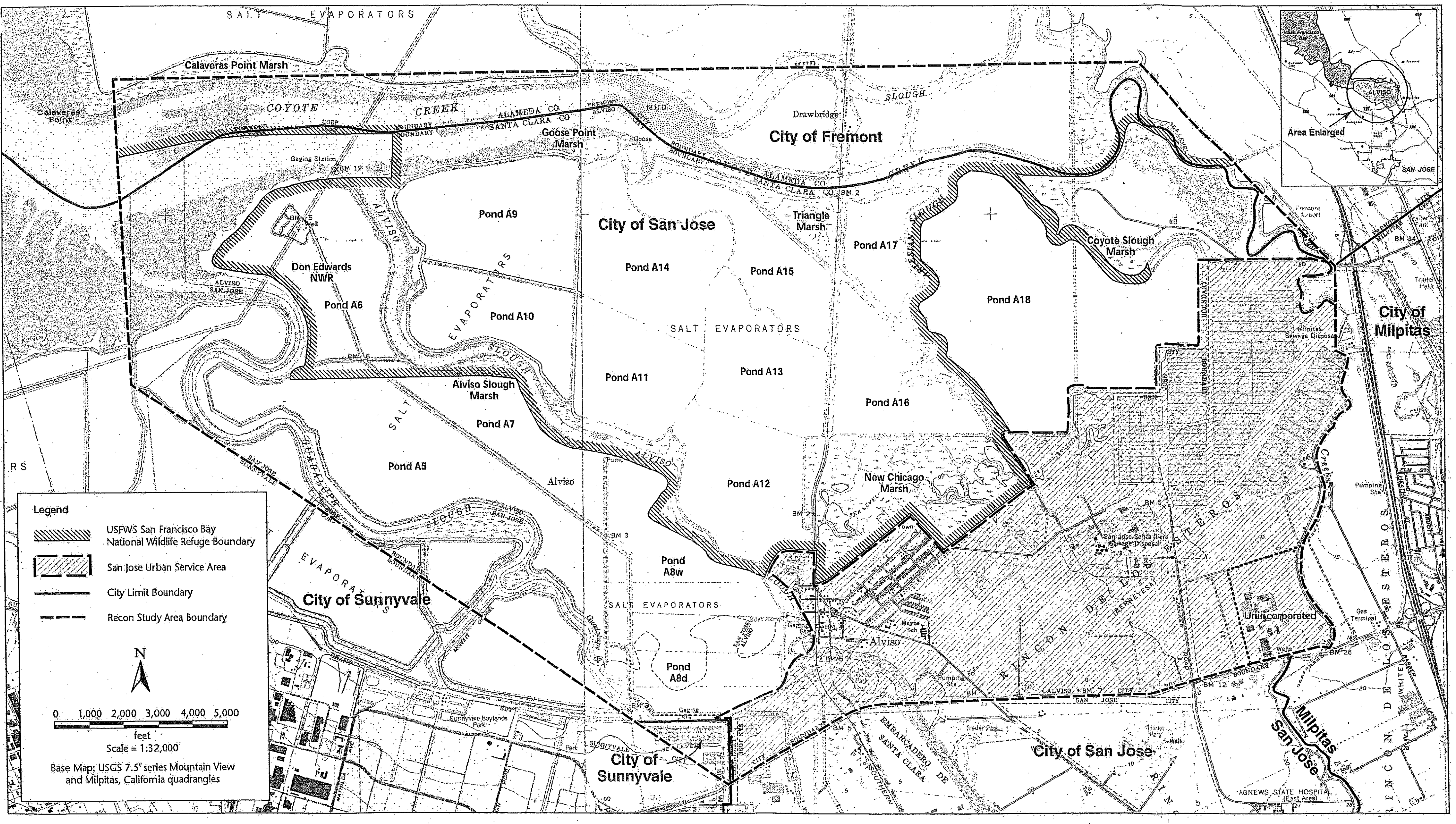

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Figure A-1
Jurisdictions Within and Surrounding the Recon Study Area

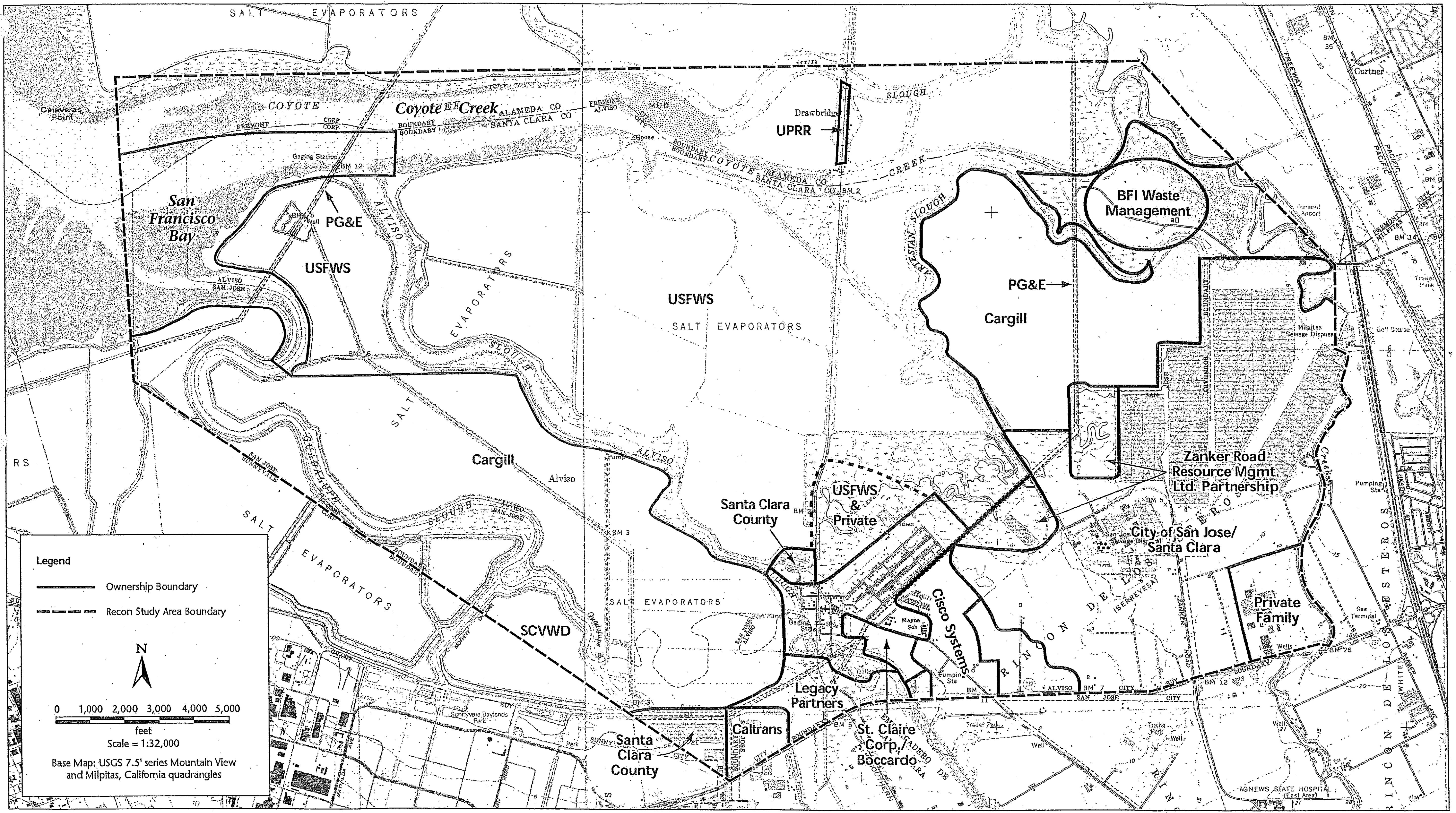


Figure A-2
Ownership of Large Parcels
Within the Recon Study Area

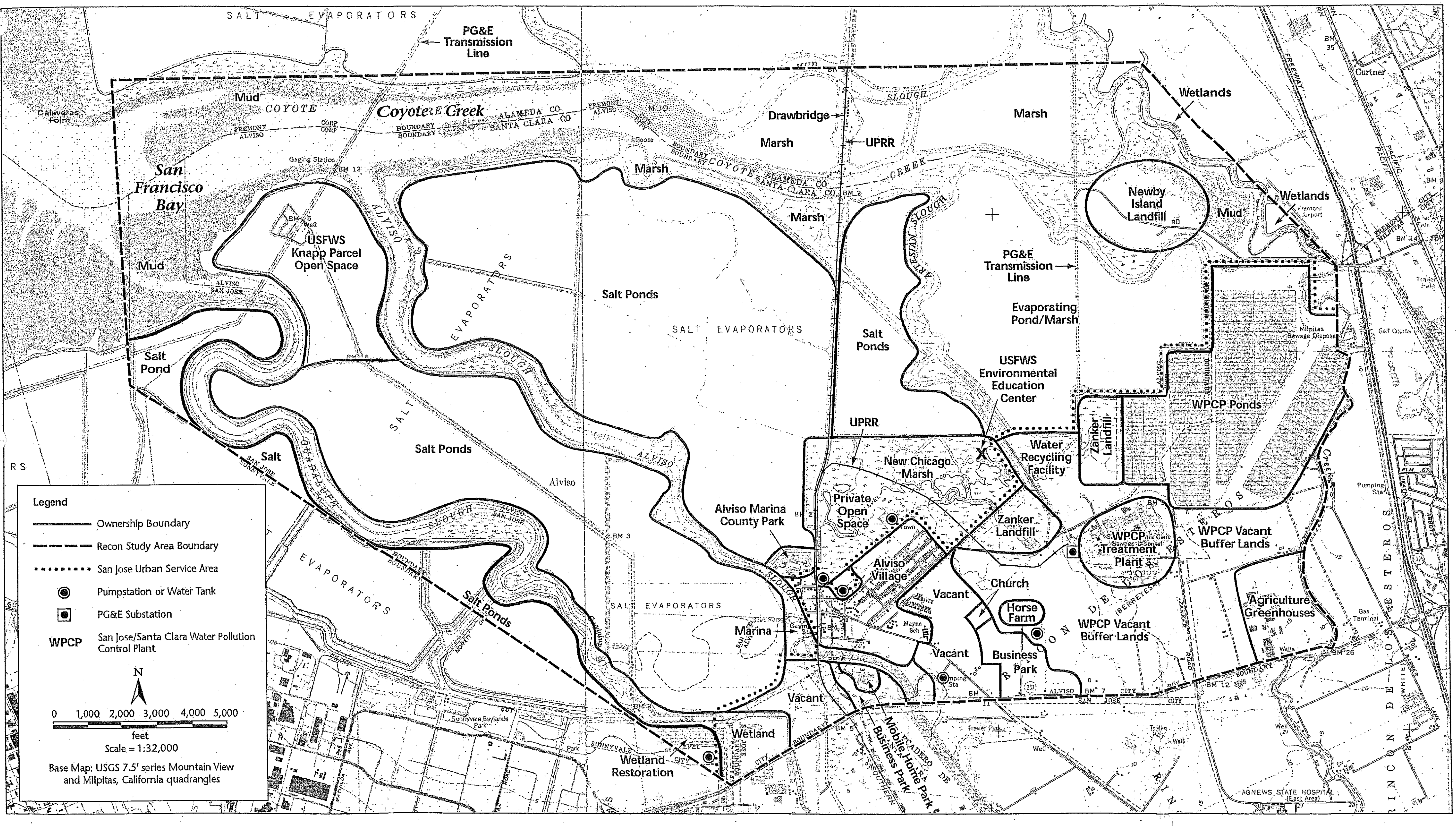
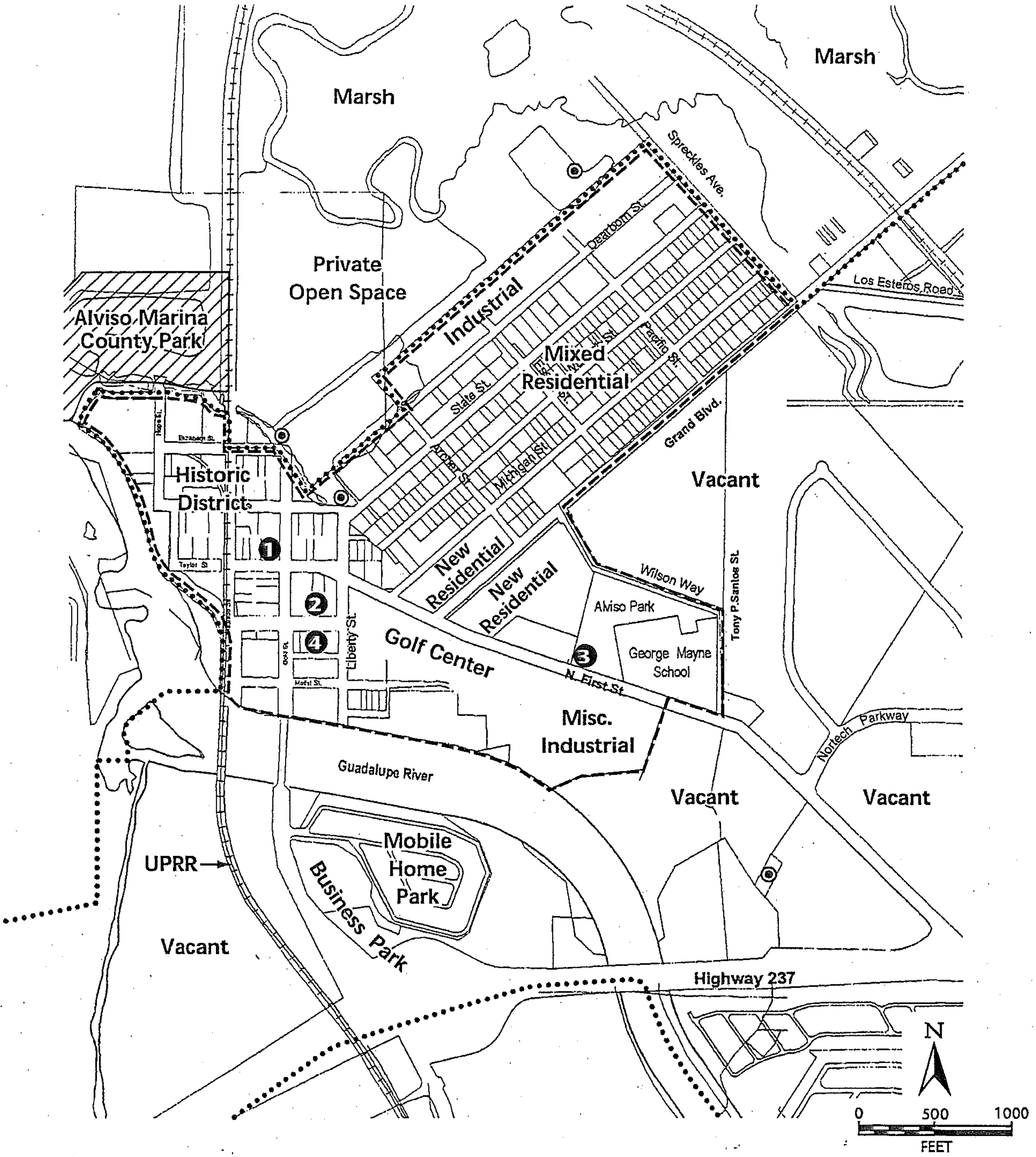


Figure A-3
Existing Land Uses in the Recon Study Area



Legend

---- Alviso Village Boundary

••••••• Urban Service Area Boundary

◎ Pumpstation or Water Tank

❶ Historic Library

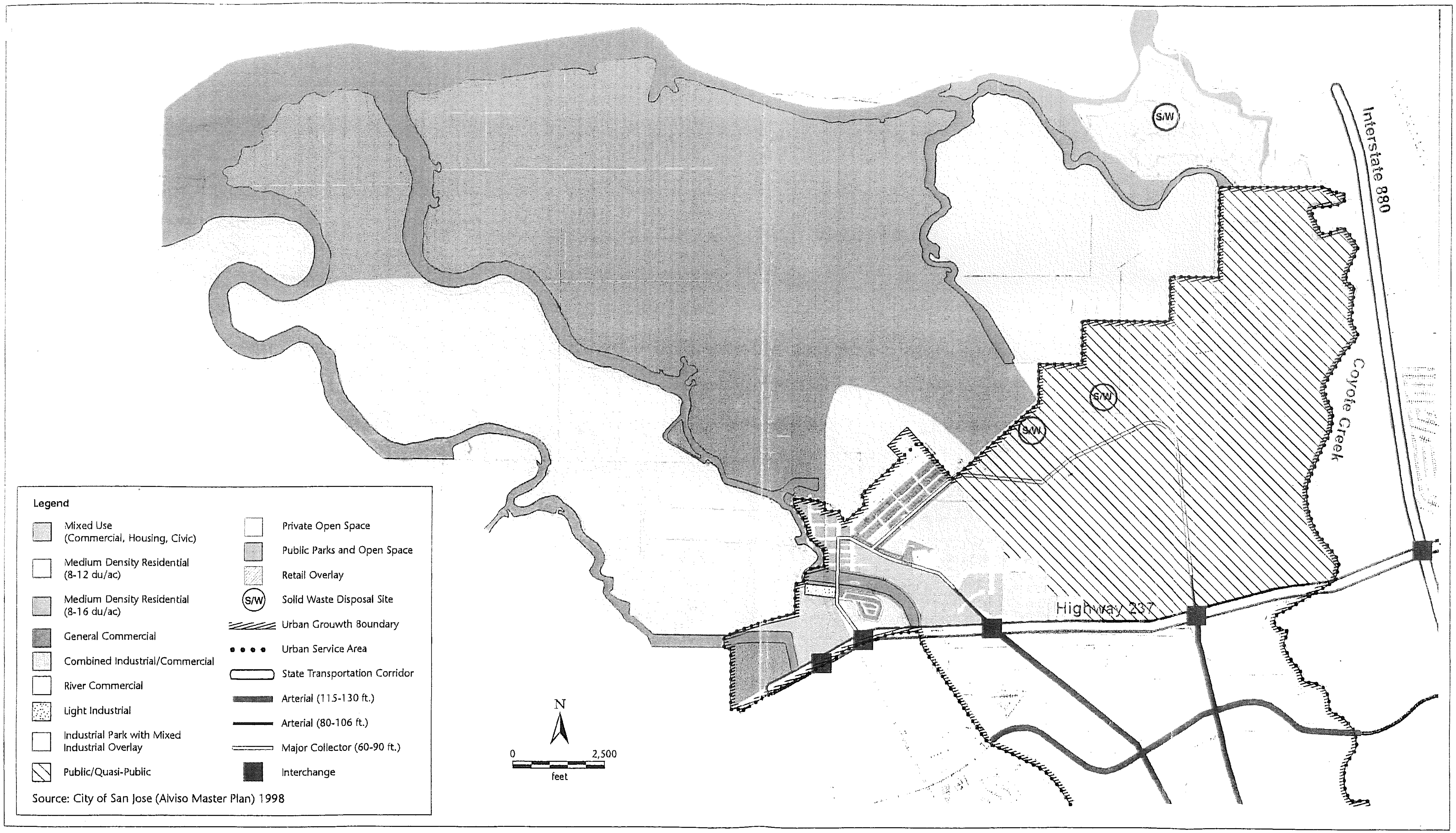
❷ Fire Station/Community Center

❸ New Library and Community Center

❹ Family Health Foundation of Alviso

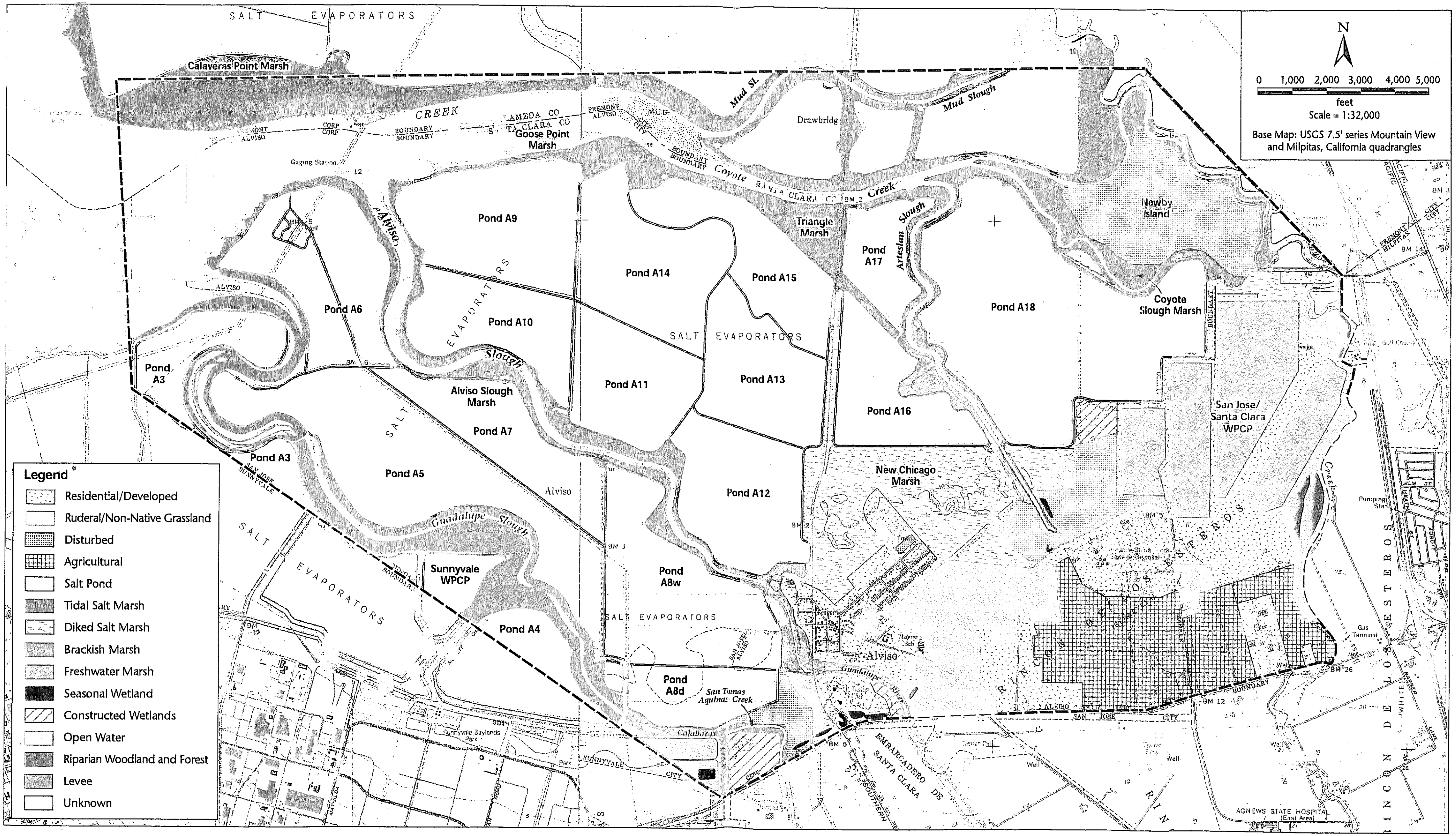
Source:
City of San Jose (Alviso Master Plan) 1998

Figure A-4
Existing Land Uses in Alviso Village


Interstate 880
Coyote Creek
Highway 237
S/W
S/W
S/W
N
0
2,500
feet
Legend
Mixed Use (Commercial, Housing, Civic)
Medium Density Residential (8-12 du/ac)
Medium Density Residential (8-16 du/ac)
General Commercial
Combined Industrial/Commercial
River Commercial
Light Industrial
Industrial Park with Mixed Industrial Overlay
Public/Quasi-Public
Private Open Space
Public Parks and Open Space
Retail Overlay
S/W Solid Waste Disposal Site
Urban Grouwth Boundary
Urban Service Area
State Transportation Corridor
Arterial (115-130 ft.)
Arterial (80-106 ft.)
Major Collector (60-90 ft.)
Interchange

Source: City of San Jose (Alviso Master Plan) 1998

Figure A-5
Alviso Master Plan Land Use Designations



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H.T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

Figure A-6
Habitat Map

* Data Courtesy of City of San Jose, Environmental Services Department

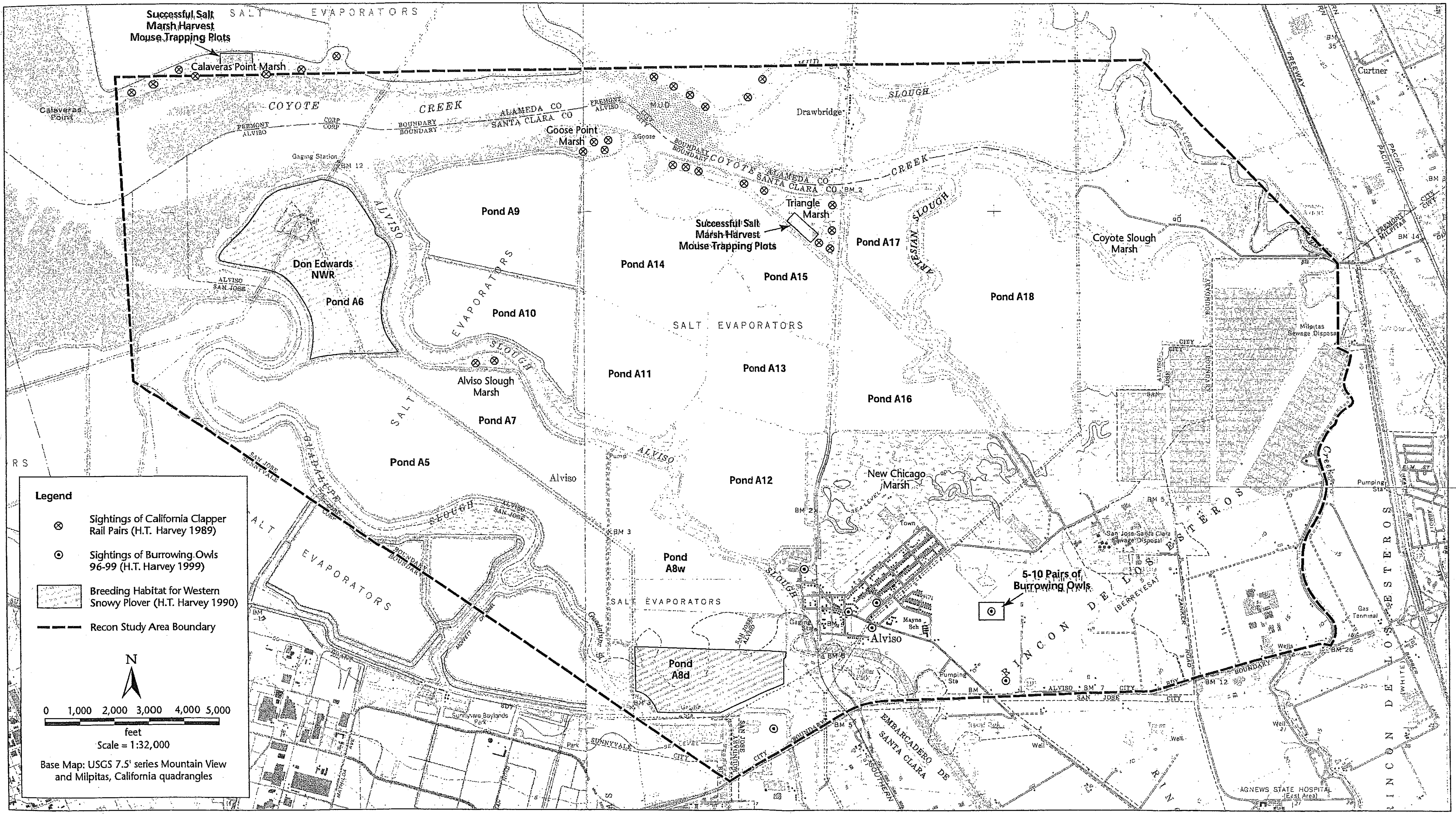

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Figure A-7
Wildlife Resources in the Recon Study Area

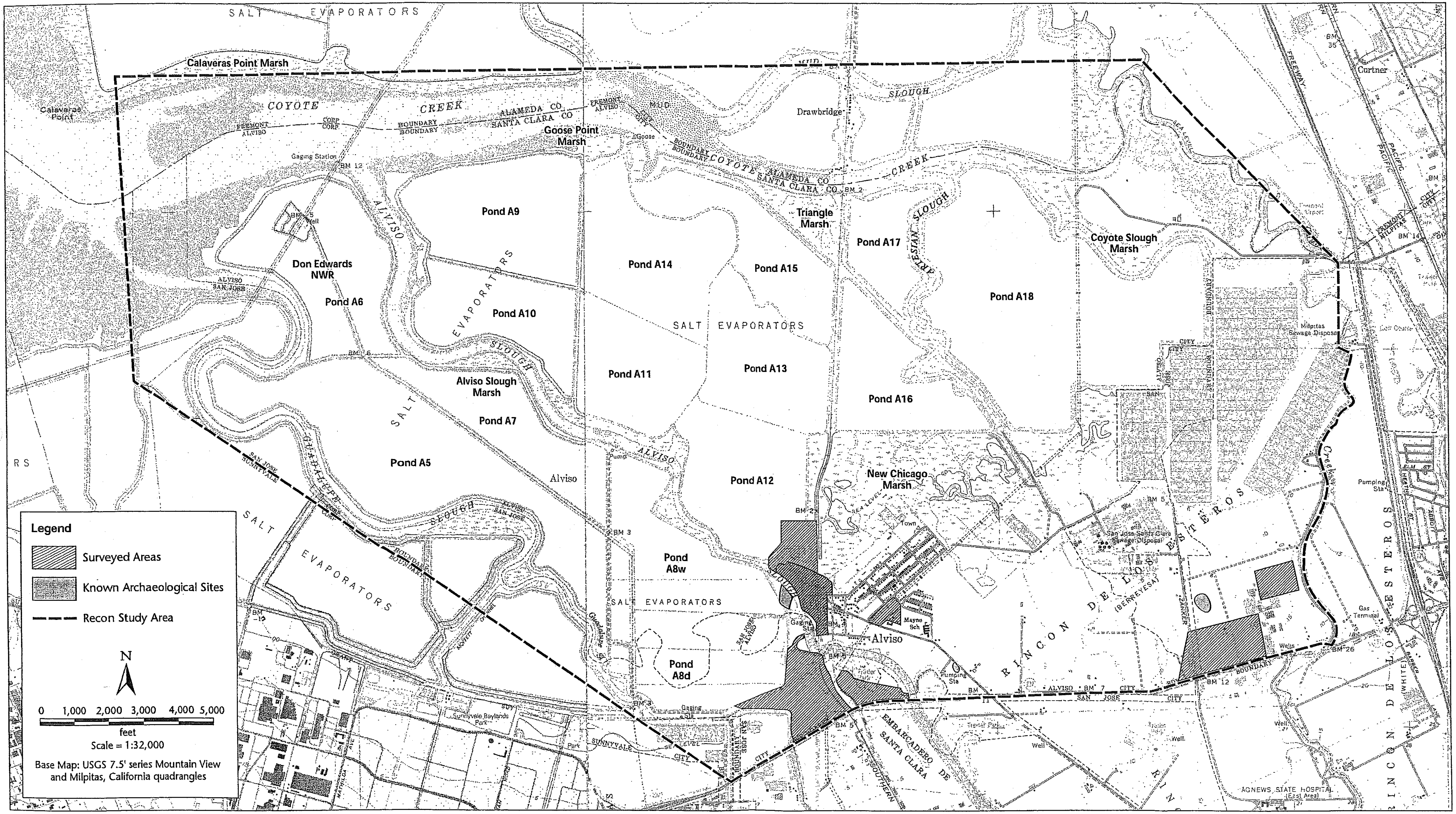

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Figure A-8
Cultural Resources Surveyed Areas and Known Sites in the Recon Study Area

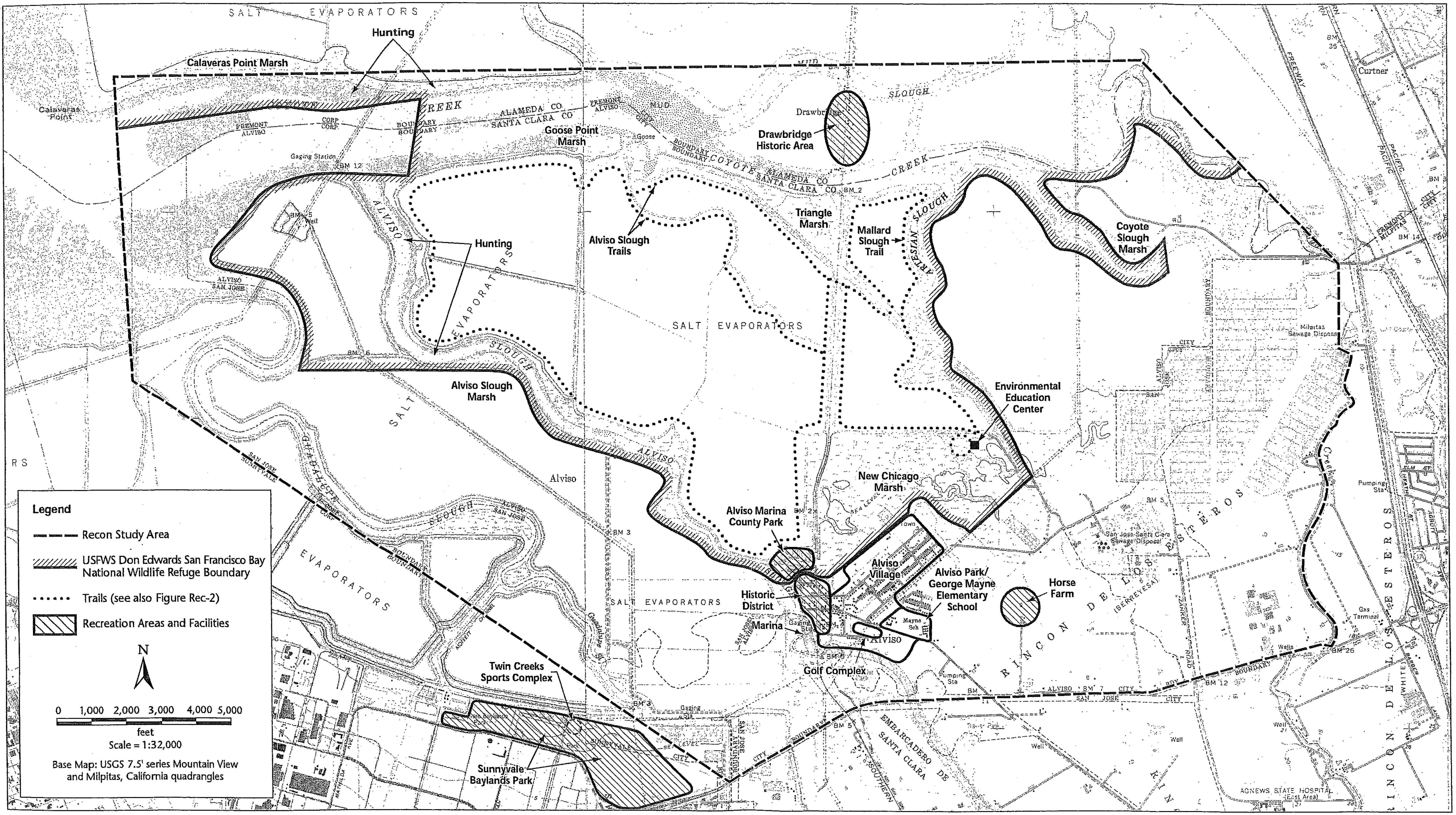

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Figure A-9
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ENVIRONMENTAL SETTING AND NATURAL RESOURCES

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A. ENVIRONMENTAL SETTING AND NATURAL RESOURCES

A.1 CLIMATE

Like the rest of the San Francisco Bay area, the Santa Clara Valley enjoys a relatively mild Mediterranean climate. Temperatures range from an average high of 82°F in July to an average low of 49°F in January (Table A-1). The area receives 90% of its rainfall in the late fall and winter months, between October and April (Table A-1); January is usually the month with the most rainfall. Although rare thunderstorms do occur in the summer months, they do not contribute significantly to net annual precipitation. Average annual precipitation in the Santa Clara Valley ranges from a high of 68 inches in the Santa Cruz mountains above Almaden Reservoir to a low of approximately 13-15 inches in San Jose. Basin-wide, rainfall averages 36.5 inches per year. For most of the year, prevailing winds are northwesterly; in winter, gentle southeasterly winds are common. Average daily windspeed is 10 mph.

Table A-1. Monthly Average Temperature and Precipitation at San Jose

(37°21'N 121°54'67"W; from National Weather Service Homepage, www.nws.mbay.net/ca clima.htm, accessed 4/2000).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Average minimum (°F)	40.6	43.9	45.4	47.1	50.9	54.6	56.6	56.8	55.8	51.6	45.5	40.7	49.1
Average maximum(°F)	58.2	62.5	65.3	70.0	74.6	79.6	82.4	82.0	80.6	74.5	64.4	57.5	71.0
Daily average (°F)	49.4	53.2	55.4	58.6	62.7	67.1	69.5	69.4	68.2	63.1	55.0	49.1	60.1
Average precipitation (in)	2.78	2.16	2.58	1.17	0.26	0.05	0.06	0.12	0.24	0.90	2.11	1.99	14.42

A.2 TOPOGRAPHY AND GEOLOGY

In the Recon Study Area, topography is relatively flat, with elevations ranging from near sea level at the Bay margin to 15 feet above mean sea level in the southeastern portion of the Recon Study Area. Extensive pumping of groundwater for agricultural and urban uses has resulted in area-wide subsidence. Between 1934 and 1967, subsidence in Alviso may have been as much as six feet; portions of Alviso are now as much as 1 foot below mean sea level, and portions of New Chicago Marsh are as much as 3 feet below sea level (City of San Jose 1998b).

Depth to bedrock in the Alviso area is estimated to range from 2,200 feet to more than 3,500 feet, according to interpretations of gravity data. The bedrock is overlain by alluvial deposits of Pleistocene age, and by older bay mud, also likely of Pleistocene age. Deposits in the shallow subsurface include: Holocene bay mud; fluvial deposits associated with the Guadalupe River, Coyote Creek, and their current and former tributaries; alluvium; and both engineered and un-engineered fill materials. The Recon Study Area is underlain by Holocene estuarine and floodplain deposits (City of San Jose 1998b).

The Santa Clara Valley is located in a structural depression of the Coast Range that has slowly filled in with sediments, creating a broad alluvial valley floor with deposits several tens of meters thick (Norris and Webb, 1990). Helley and Lajoie (1979) provide a detailed discussion of deposits and sedimentary characteristics in the Santa Clara Valley.

Rock types vary within the Guadalupe River basin. In the upper basin they consist primarily of sedimentary rocks of the Franciscan Complex. They are highly sheared and faulted, typical of the Coast Range mountains. In the lower valley floor the materials are composed of Quaternary alluvium, some of it partially consolidated. The Recon Study Area is underlain by Holocene estuarine and floodplain deposits (City of San Jose 1998b). In South San Francisco Bay and Guadalupe River estuary the materials are fine-grained bay muds. The bedrock is overlain by these alluvial deposits of Holocene age, and by older bay mud, likely of Pleistocene age. Deposits in the shallow subsurface include: Holocene bay mud; fluvial deposits associated with the Guadalupe River, Coyote Creek, and their current and former tributaries; Pleistocene alluvium; and both engineered and un-engineered fill materials

The San Andreas Fault borders the western edge of the basin and the Hayward and Calaveras Faults lie to the east. Numerous other unnamed faults also cross through the basin (DMG, 1992), all of them in a SE - NW orientation that follows the structural alignment of the Coast Range.

A.3 SOILS

Soils of the Recon Study Area have been mapped as belonging to the Alviso series, Mocho series, and Campbell series; these are soils of tidal flats and low-gradient floodplains. Areas of "made land" are also present. Much of the Recon Study Area is underlain by tidal marsh soils belonging to the Alviso series. The Alviso series consists of fine-textured soils developed on alluvium derived from sandstone and shale parent rock. Under natural conditions, soils of the Alviso series are poorly drained. Soils of the Guadalupe River and Coyote Creek floodplains belong to the Mocho series and consist of clay loam. Mocho clay loam typically overlies basin clays; in the Recon Study Area these clays are probably associated with the Alviso Series. Upland soils along the marshes and salt ponds of the area are considered "made land." They are composed of alkaline fill overlying wetland, marsh or tidal flat deposits (Soil Conservation Service 1958, Soil Conservation Service 1968).

A.4 LAND USE

A.4.1 JURISDICTION

A.4.1.1 City of San Jose

Most of the Recon Study area is within the City of San Jose and is subject to San Jose 2020 General Plan policies and land use designations (Figure A-1) (City of San Jose 1994a). The general plan is an adopted statement of policy governing long-term growth and development in the city.

The City of San Jose is divided into 15 planning areas. The Alviso Planning Area in northern San Jose includes all properties within San Jose city limits, north of Route 237, and between Coyote Creek and the Guadalupe River, an area of approximately 10,730 acres (Figure A-1). The boundaries of the Alviso Planning Area are nearly the same as those of the Recon Study Area (see Figure 1-2, main report), with the following differences:

- the northern boundary of the planning area stops at Coyote Creek, while the study area extends slightly further into the City of Fremont, and
- the southern tip of the study area includes a triangular parcel within the City of Sunnyvale (Figure A-1).

Alviso, originally established in 1840 as the embarcadero for Mission Santa Clara and incorporated in 1856, was one of the first California cities. It was an active port that received regular steamship service from San Francisco, and it flourished during the Gold Rush. The city's function as a major port declined when the railroad from San Francisco to San Jose opened in 1864 and bypassed Alviso, and again when the transcontinental railroad was completed in 1869. In 1968, Alviso residents voted to incorporate with San Jose. At that time, Alviso properties were assigned San Jose General Plan land use designations and zoning districts. Today, some of the land uses in Alviso do not conform to current zoning districts; this was one reason for the preparation of the Alviso Master Plan (City of San Jose 1998a).

The Alviso Master Plan elaborates on the San Jose 2020 General Plan (City of San Jose 1994) and sets a clear direction for future land use development within Alviso. The purpose of the Master Plan is to protect and enhance the small-town quality of Alviso via goals, policies, and implementation measures that guide appropriate new development, community facilities, infrastructure, and beautification (City of San Jose 1998a). The Master Plan focuses on the land within the Alviso Urban Service Area, which comprises approximately 2,840 acres and includes the Alviso Village area and the larger area shown in Figure A-1. The Alviso Village area is the old city area where most of the urban development is concentrated. The Urban Service Area is the area where services and facilities are generally available, and where future urban development should be located.

A.4.1.2 Cities of Fremont, Milpitas, and Sunnyvale

Portions of the Recon Study Area are within the city limits of Fremont, Milpitas, and Sunnyvale (Figure A-1). Land uses in these areas are subject to the respective city general plans. The individual city general plans are not discussed further in this document because of the nature of the land uses and the relatively small amount of land outside San Jose's jurisdiction.

The northern edge of the Recon Study Area (north of Coyote Creek) is within the City of Fremont (Alameda County). This area is dominated by Coyote Creek and its associated waterways, ponds, marshes, and wetlands (Phillips pers. comm.).

A small parcel of land between Coyote Creek and the San Jose/Santa Clara Water Pollution Control Plant in the eastern portion of the Recon Study Area is within the City of Milpitas (Santa Clara County). This area is undeveloped riverine open space and is considered part of the Coyote Creek waterway (Judd pers. comm.).

A small parcel of land at the southern tip of the Recon Study Area is within the City of Sunnyvale (Santa Clara County). The land is part of Sunnyvale Baylands Park, a county park managed and operated by the City of Sunnyvale. The parcel is located in a wetland restoration area. It includes a large rectangular pond that was used in the 1950s for depositing dredge spoils from Alviso Marina and is now part of the restored wetlands. A City of Sunnyvale water pumping station is located immediately south of the former spoils basin (Oliver pers. comm.).

A.4.1.3 Unincorporated

Approximately 145 acres of privately owned land in the southeast corner of the Recon Study Area is unincorporated but is within the San Jose sphere of influence and the Alviso Urban Service Area (Figure A-1). The land has been used for horticulture and agriculture and includes greenhouses. It is designated for light industrial use and would require annexation prior to development (Corliss pers. comm.).

A.4.2 OWNERSHIP

Based on information contained in the Alviso Master Plan, there are approximately 550 property owners in the Alviso Planning Area with holdings ranging in size from a fraction of an acre to more than 2,700 acres (City of San Jose 1998a). The largest holdings are outside the Urban Service Area (see Figure A-2) and include:

- Cargill Salt, Inc. (salt ponds),
- USFWS Don Edwards San Francisco Bay National Wildlife Refuge (SFBNWR), and
- BFI Waste Management (Newby Island Landfill).

The USFWS does not own all property within the SFBNWR boundaries. Cargill Salt retains a lifetime lease ensuring the right to use and maintain the salt evaporation ponds and levees. Other areas, including portions of New Chicago Marsh, are privately owned and are designated by the City of San Jose as "private open space." This designation is applied to privately owned lands used for low intensity open-space activity.

Within the Urban Service Area, property owners with more than 50 acres include (Figure A-2):

- Cities of San Jose and Santa Clara (various public and community facilities including the San Jose/Santa Clara Water Pollution Control Plant),
- Cisco Systems (undeveloped land designated for industrial park use),
- Zanker Road Resource Management Limited Partnership (Zanker Road landfills),
- Legacy Partners (old Highway 237 landfill area and the area east to Summerset mobile home park),
- private family (unincorporated agricultural land in southeast corner), and
- St. Claire Corp./Boccardo (Pinhigh Golf Center and adjacent lands).

This information is based on the Alviso Master Plan and was updated with telephone calls (City of San Jose 1998a; Meehan, Corliss, and Christina, pers. comms.). Other large landowners (those with more than 50 acres) mentioned in the Alviso Master Plan include Elizabeth Smith and Tuck Lin et al.

A.4.3 EXISTING LAND USES

The general distribution of existing land uses is shown on Figures A-3 and A-4. The following discussion of existing land uses is broken down by general area; land uses outside the San Jose Urban Service Area are addressed first, followed by those within the Urban Service Area. Recreational land uses are described in the "Recreation" section of this report.

A.4.3.1 Land Uses Outside the San Jose Urban Service Area

Most of the Alviso Planning Area is outside the San Jose Urban Service Area and is occupied by the Cargill salt ponds, the Don Edwards San Francisco Bay National Wildlife Refuge (SFBNWR), various waterways and wetlands, the Alviso Marina County Park, and the Newby Island landfill and recyclery (Figure A-4). The waterways, sloughs, and marshes are described in the main report; other land uses are described in the following paragraphs.

Cargill Salt Evaporation Ponds

Cargill Inc., the nation's largest private food production company, owns and operates a series of salt evaporation ponds throughout the San Francisco Bay Area. These are used to harvest salt from bay waters using evaporation driven by sun and wind. Salt water from the bay is impounded in the evaporation ponds, which are separated by levees following the contour of the landscape. Once it evaporates, salt is then scraped from the crystallizer beds and refined for use.

U.S. Fish and Wildlife Service Don Edwards San Francisco Bay National Wildlife Refuge.

The SFBNWR consists primarily of marshlands, salt ponds, and open water (Figure A-3). The SFBNWR was established by an act of Congress in 1972 to protect and manage habitat for migratory birds and endangered species, and to provide environmental education and wildlife-dependent recreation opportunities. The USFWS operates an environmental education center (EEC) at the end of Grand Boulevard near Artesian Slough. Refer to the "Recreation" section (A.10) of this appendix for a more detailed discussion of the SFBNWR.

New Chicago Marsh

New Chicago Marsh is part of the SFBNWR and is located outside the Urban Service Area immediately north of Alviso Village. Most of the marsh is contained between the Union Pacific railroad tracks and Artesian Slough (Figure A-3). The existing Urban Service Area boundary includes a short peninsula intruding into the marsh; this is the site of a former wastewater treatment plant that has reverted to wetlands.

Much of New Chicago Marsh is owned by the USFWS and is now being preserved and restored as salt marsh. The EEC and the New Chicago Marsh trail, part of which is a boardwalk through the marsh, are located in the northeastern portion of the marsh. Parts of the marsh, including the salt ponds and the privately owned land along Spreckles Avenue that extends into the marsh proper, are still privately owned and are designated as private open space. Much of the private open space is on filled lands and is employed for existing industrial uses, primarily outdoor storage. It is the ultimate desire of the City of San Jose and USFWS that this land will be restored to its previous state as tidal salt marsh (City of San Jose 1998b; Corliss and Kolar pers. comm.).

Alviso Marina County Park

This 29-acre bayside park is part of the Santa Clara County Parks system. It provides opportunities for picnicking and bird watching and also permits access to the recreation trails in the SFBNWR. Refer to the "Recreation" section (A.10) of this appendix for more information on Alviso Marina County Park.

Newby Island Landfill

The Newby Island landfill and recycling center are located in the northeastern portion of the Recon Study Area. The landfill is owned by BFI Waste Management and is under contract to accept city waste for another 18 years (Christina pers. comm.). When the landfill closes, the City of San Jose intends the land to remain private open space. A general plan amendment is on file that would permit the installation of radio transmission towers on the site (Corliss pers. comm.).

A.4.3.2 Land Uses Within San Jose Urban Service Area

Existing land uses within the San Jose Urban Service Area are shown in Figures A-3 and A-4. Information presented here was drawn from results of a reconnaissance field survey and from the Alviso Master Plan (City of San Jose 1998a). The land uses are described by land use type, with some of the major land uses described separately. The three main roadways into the Alviso Urban Service Area are Gold Street, North First Street, and Zanker Road/Los Esteros Road.

Alviso Village

The Alviso Village area includes the historic district (the western grid), the neighborhood grid, and the lands on both sides of North First Street from Liberty Street to the southern boundary of George Mayne Elementary School (Figure A-4). Gold Street enters the heart of the Alviso historic district where there are restaurants, small grocery stores, office buildings, historic buildings, a post office, a health clinic, a fire station, a community center, the old town library, trucking operations and other industrial uses, a variety of residences, and scattered vacant lots. The 60-acre historic district is generally bounded by Alviso Marina County Park, Guadalupe River/Alviso Slough, Moffat Street, and El Dorado Street (Figure A-4). The neighborhood grid east of the historic district can be characterized as generally supporting industrial uses north of State Street and residential uses between State Street and Grand Boulevard (Figure A-4). The southern area of Alviso, in the vicinity of North First Street, includes the Pinhigh Golf Center, George Mayne Elementary School, Alviso Park, and the new library and community center (City of San Jose 1998a).

San Jose/Santa Clara Water Pollution Control Plant and Vicinity

The San Jose/Santa Clara Water Pollution Control Plant (WPCP) treats water from homes and businesses in the cities and unincorporated areas within Santa Clara County. The WPCP is owned by the Cities of San Jose and Santa Clara, and is operated by the San Jose Environmental Services Department on behalf of several tributary agencies. Most of the treated water is discharged into the Bay via Artesian Slough at the South Bay Recycled Water Station (Figure A-3).

The WPCP treatment facility is surrounded by several hundred acres of undeveloped open space, some of which was in agricultural production until 1998 and 1999. The land serves as a buffer to the treatment facility and is reserved for future expansion of the treatment facility. Aside from the land near Nortech Drive leased by Arzino Horse Farms, there are no other residents or tenants on WPCP land (Figure A-3) (Meehan pers. comm.).

Landfills

There are several landfills in the Recon Study Area and within the Urban Service Area. Zanker Material Processing Facility occupies two sites of approximately 80 acres each. They are located north of the WPCP, off Los Esteros Road (Figure A-3). The landfills are privately owned and operated by the Zanker Road Resource Management Limited Partnership, which purchased the sites from Owens Corning in 1998. Although the facility accepts solid waste, its primary activities are associated with recovering recyclable materials (Christina pers. comm.). The South Bay Recycled Water Station, which is part of the WPCP operation discussed in the preceding section, is located between the two landfill sites.

The old Highway 237 landfill is located at the southern tip of the area west of Gold Street (Figure A-3). The site is now owned by Legacy Partners, but was previously owned by Lincoln Property and Marshland Development Corporation. A specific plan for future industrial and commercial development of the site has been drafted, but the plan has not begun the city approval process. Refer to the discussion of "Future Land Uses" in the following section (A.4.5) of this appendix for additional information.

Residential

Most of the existing residential units are clustered in the Alviso Village area. They include single-family residences with some duplexes, triplexes and small apartment buildings. In addition, the Summerset Mobile Home Park is located on the east side of Gold Street south of the Guadalupe River. New single-family housing is slated for construction on both sides of Grand Boulevard at North First Street (Figure A-4). One of the residential developments, consisting of several 4 bedroom/3 bathroom homes, is currently under construction. Refer to the "Socioeconomics" section (A.5) of this appendix for more information on housing.

Commercial/Industrial

Commercial and industrial uses are generally found throughout the urban area, both within and south of the Alviso Village area. Light industrial uses that include outdoor storage, truck yard and maintenance facilities, manufacturing, and other industrial businesses are primarily located in the older area of town north of State Street, along Gold Street, and west of Taylor/Liberty Streets (Figure A-4).

Business Park

Business park development in Alviso represents an extension of business park development south of Highway 237 along North First Street.

There are industrial/business park developments off Nortech Parkway, east of North First Street and north of Highway 237. Development includes Baytech Park, North San Jose Technology Center, and the Jubilee Christian Center. Undeveloped land to the west of the existing business park and church is also designated for industrial park and commercial development. The newly constructed Legacy Technology Park is located on Gold Street just south of the Guadalupe River (near Summerset Mobile Home Park) with vacant land designated for business park and restaurant development across the street.

Undeveloped Open Space/Vacant Land

The Alviso Urban Service Area encompasses a substantial amount of undeveloped open space. Most of the land is owned by the San Jose/Santa Clara WPCP and is intended for buffer lands and future expansion. Other undeveloped land designated for future development includes: the Cisco Systems property that extends south of Grand Boulevard past North First Street, the St. Claire Corporation/Boccardo property between Liberty Street and North First Street, and the old Highway 237 landfill and lands immediately east owned by Legacy Partners (Figure A-3). The land west of the old Highway 237 landfill site is a wetland mitigation area that will be preserved as permanent open space. Additionally, several smaller undeveloped or vacant parcels are scattered on the north and south sides of the Guadalupe River and throughout Alviso Village.

Agricultural Land

Agricultural production has historically taken place on lands owned by the San Jose/Santa Clara WPCP. Row crops were grown until 1998–1999; although the land is reserved for future WPCP expansion, it may be put back into cultivation in the interim (Meehan pers. comm.). Agriculture is also the primary use on approximately 145 acres of privately owned land located in the southeast corner of the Recon Study Area adjacent to Highway 237 and Coyote Creek. The Soil Conservation Service (now the Natural Resources Conservation Service) designated approximately 490 acres of land as prime farmland (most on WPCP property) and 72 acres as farmland of statewide importance (on Cisco property) (City of San Jose 1998b).

A.4.4 MAJOR UTILITIES AND TRANSPORTATION CORRIDORS

A.4.4.1 Railroad

The Union Pacific Railroad tracks extend north-south through the Recon Study Area. The railroad line was owned and operated by Southern Pacific Railroad until the company merged with Union Pacific in 1996. From the south, the railroad runs adjacent and parallel to the west side of Gold Street. North of Alviso Village, the railroad continues on levees through the New Chicago Marsh and the salt evaporation ponds, over Coyote Creek and through the old community of Drawbridge, and from there north through the City of Fremont. Main Street in Drawbridge follows the railroad tracks. A spur track through the New Chicago marsh enters the Water Pollution Control Plant to facilitate the delivery of supplies (City of San Jose 1998a).

These tracks support both Amtrak passenger and Southern Pacific freight trains. Passenger trains (the Amtrak Capitol Corridor, Altamont Commuter Express, and Starlight Express) typically run daily between 6:30 a.m. and 9:30 p.m. Freight trains run daily without specified hours of operation. There are no passenger train stations in Alviso (City of San Jose 1998a).

A.4.4.2 Transmission Lines

Two large overhead Pacific Gas & Electric (PG&E) electricity transmission corridors traverse the Recon

Study Area (Figure A-2). Both extend from the PG&E Newark generation plant north of the Recon Study Area. One transmission corridor, composed of three transmission lines, extends through the northwest portion of the Recon Study Area into the USFWS Knapp parcel and from there into the Cupertino area. The other transmission corridor, composed of two electric lines, extends into the San Jose area through the eastern portion of the Recon Study Area and runs southwest parallel to Grand Boulevard before continuing south out of the study area. In addition, two feeder lines connect the Grand Avenue corridor to an electric substation located at the WPCP (Espinosa pers. comm.).

A.4.4.3 Pump Stations and Water Tanks

The following pumping stations and water tanks were identified during the reconnaissance site visit and are shown on Figures A-3 and A-4:

- City of San Jose Gold Street water pumping station (in Alviso Village at Gold Street/Elizabeth Street);
- City of San Jose Alviso water pumping station (in Alviso Village at Catherine Street/State Street);
- City of San Jose Spreckles sanitary pumping station (on northern boundary of Alviso Village, east of Spreckles Avenue);
- Nortech water tank and pumping station (at the end of Nortech Parkway);
- City of Santa Clara sewer station (at the end of the dirt road opposite Nortech Parkway on the east side of North First Street); and
- City of Sunnyvale water pumping station (at the southern tip of the Recon Study Area).

A.4.4.4 Roadways

Highway 237 forms the southern boundary of the Alviso Planning Area. Highway 237 is a major sub-regional corridor linking many South Bay cities. It connects Interstate 680 in Milpitas on the east with Highway 101 in Sunnyvale on the west. Interstate 880 extends along the eastern boundary of the Recon Study Area, east of and roughly parallel to Coyote Creek (Figure A-5).

Although they are not considered major transportation corridors, three roadways provide access to the Alviso Planning Area from north San Jose: Gold Street provides the westernmost access, North First Street provides central access, and Zanker Road provides the easternmost access. Alviso has five major collector roads (60–90 feet wide): Zanker Road, Grand Boulevard, Los Esteros Road, Gold Street, and the portion of North First Street from Grand Boulevard to Gold Street.

Most streets in Alviso are considered local streets, serving only the immediate community. They are arranged in a traditional grid pattern (Figure A-4). With the exception of the Highway 237 freeway on-ramps, there are no traffic signals in Alviso. Stop signs provide primary traffic control.

A.4.5 FUTURE LAND USES

A.4.5.1 Anticipated Land Uses

Future land uses in undeveloped open space areas can be reasonably anticipated based on the Alviso Master Plan Land Use Designations map (Figure A-5). Known projects include the following (Corliss pers. comm.):

- Cisco Systems Site 6 – Cisco Systems prepared a specific plan for the development of 152.6 acres on the east side of North First Street, north of Highway 237. The plan includes approximately 2.35 million square feet of office, research and development, and light industrial uses. The public review period for the draft EIR ended January 31, 2000 (www.ci.san-jose.ca.us).

- Cargill Properties/Legacy Terrace – The Cargill landfill (Highway 237 landfill) site is located west of Gold Street, between Guadalupe River and Highway 237. Legacy Partners currently owns the land (formerly owned by Lincoln Property). The Legacy Terrace project divides the site into three parts. The South Campus area (approximately 38.8 acres) provides for the construction of five commercial buildings (1 million square feet of office space), a 175-room hotel, and associated parking. The Riverfront Commercial area (approximately 6.4 acres) includes areas near the Guadalupe River that will be used for restaurant, retail or community facilities. The Open Space Preserve (approximately 25.3 acres) will be located in the northern portion of the project site, adjacent to San Tomas Aquinas Creek and the existing Cargill salt ponds (H.T. Harvey & Associates 1999). A specific plan has been drafted, and the public review period for the draft EIR ended December 6, 1999. However, the specific plan has not begun the city approval process (Corliss pers. comm.) (www.ci.san-jose.ca.us).

- Lincoln/Highway 237 Assemblage – This project site includes the strip of land bounded by Gold Street on the east, the Southern Pacific railroad tracks on the west, the Guadalupe River on the north, and Highway 237 on the south. This parcel was analyzed as parts 3 and 4 of the Highway 237 Assemblage project (H.T. Harvey & Associates 1997). Parts 1 and 2 are the components of Legacy Technical Park across Gold Street. Current planned uses include a research and development facility and a restaurant.

- WPCP expansion – As the San Jose/Santa Clara region continues to grow, the San Jose/Santa Clara WPCP will likely need to expand into undeveloped WPCP-owned lands adjacent to the existing treatment plant.

A.4.5.2 Development Constraints

Several constraints would limit future development in the Alviso Planning Area. These include:

- potential for flooding (see below);
- existing historic resources and potential for prehistoric and/or paleontological resources;
- geological/soils constraints resulting from the presence of expansive soils, marshland, landfills, and undocumented fill;
- sensitive biological resources associated with the wetlands, marshes, grasslands, and riparian areas along the creeks (see below);
- hazardous materials associated with landfills, auto and boat repair and painting, trucking operations, metalworking, railway lines, agriculture, and operation of the WPCP;
- noise from airplanes, railroads, and freeways; and
- need for compliance with policies and planning guidance in the Alviso Master Plan and San Jose 2020 General Plan (see below).

Flooding is the focus of current studies related to the preparation of this report. Alviso's flat topography and its location in natural floodplains make it prone to flooding. This has been further exacerbated by land subsidence of as much as six feet caused by extensive groundwater pumping for agricultural and urban uses between 1934 and 1967; as a specific example, the historic area of Alviso was once above the banks of the Guadalupe River. As a result, development in Alviso and other flood-prone areas is governed by the City of San Jose's Flood Hazard Area Ordinance, which requires that all new construction or substantial remodeling of existing structures in Alviso have first-floor elevations approximately 10 feet above sea level. Therefore, new single-family homes in Alviso typically have a garage on the ground floor and living areas on the second floor.

Environmental Protection Policy 4 in the Alviso Master Plan states that certain lands must be set aside to provide habitat needed to mitigate the loss of specific wildlife habitat as a result of previous development. Priority locations for habitat preservation include: portions of the city-owned land at the WPCP, certain properties in New Chicago Marsh, portions of the former Highway 237 landfill, and property adjacent to Coyote Creek.

The Alviso Master Plan also calls for "master planning" of certain key portions of the Alviso area. This is designed to maintain adequate open space, to provide for wildlife mitigation, and to ensure general plan compliance. Portions of Alviso targeted for master planning include: the Cisco properties on both sides of North First Street, the former Highway 237 landfill site east of Gold Street, and the St. Claire Corporation property on the east side of North First Street.

A.5 SOCIOECONOMIC CONDITIONS

This section describes patterns of population, housing, and employment in the Recon Study Area. As stated previously, the boundaries of the Recon Study Area generally coincide with those of the City of San Jose's Alviso Planning Area; therefore, the socioeconomic characteristics of the Alviso Planning Area represent those of the Recon Study Area. Much of the information in this section is based on 1990 census data and was obtained from the Alviso Master Plan (City of San Jose 1998a) and San Jose 2020 General Plan (City of San Jose 1994a). Updated information will be available approximately April 2001 as a result of Census 2000 (Harris pers. comm.). Table A-2 summarizes relevant economic statistics.

A.5.1 POPULATION

In 1990, Alviso had a relatively small population of 2,195. This represented only 0.28% of San Jose's total population of 782,248. Children made up a high proportion of Alviso's population; 34% of Alviso residents were 15 years of age or younger (City of San Jose 1998a), compared to 24% for the City of San Jose (City of San Jose 1994a).

Hispanics accounted for nearly 71% of Alviso's population in 1990, compared to 26% in San Jose. Spanish was the primary language spoken in 61% of all homes in Alviso. Almost all Hispanics in Alviso were of Mexican origin (City of San Jose 1998a).

A.5.2 HOUSING

In 1990 there were approximately 590 housing units in the Alviso Planning Area (Harris pers. comm.), and 259,365 in San Jose overall (City of San Jose 1994b). Housing in Alviso includes single-family residences, duplexes and triplexes, and small apartments. Most of the residences are located in the

Table A-2. Alviso Socioeconomic Characteristics in 1990

1990 Census Information	Alviso Planning Area	San Jose overall
Total population	2,195	782,248
Persons per household	3.82	3.08
Total # of housing units	590	259,365
Proportion of renters	51%	39%
Median gross rent	$589/month	$755/month
Median value for-sale housing	$166,300	$257,500
Per capita income (1989)	$8,973	$16,905
Median household income	$33,859	$46,206
People living beneath poverty level	15.8%	9.3%

Sources: City of San Jose (1994a, 1994b, 1998a) and (Harris pers. comm.).

neighborhood grid outside the historic district (Figure A-4). Compared to San Jose overall, housing in Alviso was more crowded as of 1990 and renter-occupied units accounted for 51% of Alviso housing, a substantially higher percentage than in San Jose. In addition, housing in Alviso tends to be older than the San Jose average; more than 80% of the housing stock was built before 1980 (City of San Jose 1998a).

A.5.3 EMPLOYMENT

In 1990, there were an estimated 2,000 jobs in Alviso, representing less than 1% of the jobs in San Jose. Employers in Alviso include several businesses in the Alviso Village area as well as surrounding industries, such as the San Jose/Santa Clara Water Pollution Control Plant and the area's landfills. More recently, employment has included offices and businesses in the southern portion of the planning area near Highway 237.

The San Jose General Plan estimates that 1,000 new jobs will be added between 1990 and 2010. Again, this number is less than 1% of the total job growth projected in the City of San Jose (City of San Jose 1994b). Based on general plan land use designations, these jobs will be related to the industrial/business parks. This is consistent with the land use designations for large undeveloped parcels in the planning area.

Incomes in Alviso were lower than those in San Jose as a whole. In 1989, the average per capita income in Alviso was $8,973, compared to $16,905 in San Jose. The median household income in Alviso was $33,859, compared to $46,206 in San Jose. With the rapid growth of the high-tech industry in San Jose, the present median income in San Jose overall is now probably substantially higher than it was in 1989. Consequently the salary gap between the Alviso Planning Area and San Jose overall is probably correspondingly wider (City of San Jose 1998a).

According to the 1990 census, 15.8% of people in Alviso live beneath the poverty level, compared to 9.3 % in San Jose and 7.3% in Santa Clara. The poverty rate in Alviso increased by more than 100% between 1980 and 1990. During the same time period, the poverty rate in San Jose increased by 50% (City of San Jose 1998a).

A.6 AIR QUALITY

A.6.1 METHODS

Information in this discussion of air quality in the Recon Study Area was gathered from air quality studies previously carried out in this vicinity. The Alviso Master Plan (City of San Jose 1998a) provides information about local air quality in the Alviso area, which forms a large part of the Recon Study Area. Meteorological information is given in the San Jose 2020 General Plan Final Environmental Impact Report (City of San Jose 1994b). The San Jose 2020 General Plan (City of San Jose 1994a) includes information on regional air pollutants. The Air Resources Board website (www.arb.ca.gov/homepage.htm) supplies information regarding current federal and state air pollution standards, air quality data from local monitoring sites, and information on air quality attainment status in various parts of California, including the San Jose area.

A.6.2 CLIMATE

Meteorological data are available from the National Weather Service's San Jose station (see Table A-1). Data collected at San Jose show a minimum temperature of 41° F recorded during the month of January, and a maximum of approximately 82° F measured in July, with a mean annual temperature of 59.7° F. The area has a Mediterranean climate with little precipitation in the summer months and moderate precipitation in the winter months; the average annual precipitation recorded at the San Jose monitoring station between 1951 and 1989 was 13.86 inches, falling mainly between October and April. Winds typically blow from the northwest, except during the winter when winds are typically gentle and from the southeast. Average daily wind speed is 10 mph.

Air pollution levels reflect the concentrations of pollutants in the ambient air. Pollutant concentrations depend on an area's ability to transport and dilute pollutants, which is generally controlled by wind conditions and atmospheric stability. The topography of the Santa Clara Valley has the potential to create atmospheric conditions that trap pollutants, because the Santa Cruz Mountains on the west and the Diablo Range on the east prevent horizontal movement of air away from the area. Northerly and northwesterly prevailing winds carry pollutants from automobiles and factories on the Peninsula into the Santa Clara Valley. During the fall and winter months in particular, calm wind conditions in the San Jose area contribute to the retention of pollutants in this region. Additionally, inversion layers are common in the San Jose area; they trap cold air under warm air, leading to significant increases in pollutant levels at and near ground level.

A.6.3 REGIONAL AIR QUALITY STANDARDS

Air pollutant emissions in California are regulated by several agencies. At the federal level, the U.S. Environmental Protection Agency directs state and local implementation of the federal Clean Air Act. At the state level, the California Air Resources Board (ARB), under the jurisdiction of the California Environmental Protection Agency, regulates levels of directly emitted mobile-source and fuel-content pollutants. For administrative purposes, the state is divided into a number of local air basins within which air pollution control and air quality management districts are responsible for controlling stationary and indirect sources of air pollution, for air quality monitoring, and for preparing air quality management plans. The Santa Clara Valley, including the Recon Study Area, is located in the San Francisco Air Basin (SFAB) and is under the jurisdiction of the Bay Area Air Quality Management District (BAAQMD).

The BAAQMD's Clean Air Plan (CAP) was approved in 1991 by the ARB and was updated in 1994 and 1997. The CAP was written with the purpose of bringing ozone levels in the SFAB into attainment. The CAP calls for increasing controls on stationary, mobile, and area air pollution sources. This includes increased control measures for existing stationary sources, a permitting program that will prevent increases in net emissions from stationary sources, transportation control measures, and controls on indirect sources.

In California, the federal and state Clean Air Acts and the California Health and Safety Code require monitoring of ambient air to ensure that air pollutant levels remain at low enough concentrations to be safe for human exposure (Table A-3). The closest air-quality data collection site to the Recon Study Area is the BAAQMD's downtown San Jose monitoring station.

Table A-3. Summary* of Air Quality Data for Downtown San Jose

Pollutant	Standard	1995	1996	1997	1998	1999
Ozone	Federal 1-Hour 0.12 ppm	1	0	0	1	0
Ozone	State 1-Hour 0.09 ppm	14	5	0	4	0
Ozone	Federal 8-Hour 0.08 ppm	3	0	0	1	0
PM10	Federal 24-Hour 150 micrograms/cubic meter	0	0	0	0	0
PM10	State 24-Hour 50 micrograms/cubic meter	4	2	3	3	1
CO	State/Federal 8-Hour 9.0 ppm	0	0	0	0	0
NO_2	State 1-Hour 0.25 ppm	0	0	0	0	0

** Information taken from the Air Resources Board homepage*
www.arb.ca.gov:8080/cgi-bin/db2www.exe/adamquery.mac/start

A.6.4 ATTAINMENT STATUS

Pollutants in the San Jose area include ozone, particulate matter, oxides of nitrogen (NO_x), and carbon monoxide (CO). Both ozone and particulate matter are considered area source pollutants, meaning that they are distributed in relatively equal concentrations over the area. Carbon monoxide is a localized source pollutant that occurs in high concentrations in specific areas, such as busy intersections where large numbers of autos idle, accelerate, and decelerate. Areas of high CO concentration are located primarily outside the Recon Study Area in regions of higher population density. The U.S. Environmental Protection Agency currently classifies the Bay Area as a non-attainment area for ozone. Santa Clara County is currently in non-attainment under the California Clean Air Act for both ozone and PM10. NO_x and CO concentrations in the San Jose area have also exceeded the state or federal ambient air laws in recent years. The following paragraphs present more detailed information on each of these pollutants. Table A-4 summarizes federal and state air quality standards.

Table A-4. Ambient Air Quality Standards Applicable in California

This table summarizes the standards established by the State and Federal governments for key pollutants. The California standards represent concentrations that should never be exceeded.

			Standard, as parts per million		Standard, as micrograms per cubic meter		Violation Criteria	
Pollutant	**Symbol**	**Average Time**	**California**	**National**	**California**	**National**	**California**	**National**
Ozone	O_3	8 hours	N/A	0.08	N/A	160	N/A	If 3-year average of annual third-highest daily 8-hour maximum exceeds standard
		1 hour	0.09	0.12	180	235	If exceeded	If exceeded on more than 3 days in 3 years
Carbon monoxide	CO	8 hours	9.0	9	10,000	10,000	If exceeded	If exceeded on more than 1 day per year
		1 hour	20	35	23,000	40,000	If exceeded	If exceeded on more than 1 day per year
Nitrogen dioxide	NO_2	Annual average	N/A	0.053	N/A	100	N/A	If exceeded
		1 hour	0.25	N/A	470	N/A	If exceeded	N/A
Sulfur dioxide	SO_2	Annual average	N/A	0.03	N/A 105	80	N/A	If exceeded
		24 hours	0.04	0.14		365	If exceeded	If exceeded on more than 1 day per year
		1 hour	0.25	N/A	655	N/A	N/A	N/A
Inhalable particulate matter	PM10	Annual geometric mean	N/A	N/A	30	N/A	If exceeded	N/A
		Annual arithmetic mean	N/A	N/A	N/A	50	N/A	If exceeded
		24 hours	N/A	N/A	50	150	N/A	If exceeded on more than 1 day per year
Fine particulate matter	PM2.5	Annual arithmetic mean	N/A	N/A	N/A	15	N/A	If spatial average exceeded on more than 3 days in 3 years
		24 hours	N/A	N/A	N/A	65	N/A	If exceeds 98th percentile of concentrations in a year

Notes:
All standards are based on measurements at 25°C and 1 atmosphere pressure.
National standards shown are the primary (health effects) standards.

N/A = not applicable.

A.6.4.1 Ozone

Ozone exposure can cause a variety of problems in areas in which it reaches unsafe levels. Ozone exposure increases the chances of respiratory infection, chest pain, cough, lung inflammation, and chronic bronchitis in humans, and can damage the leaves of crops and natural vegetation. Because ozone is an oxidant, it can also have a negative effect on a variety of artificial materials.

To minimize the destructive capabilities of ozone, both the federal government and the state of California have set standards to limit ozone levels in ambient air. The federal 1-hour ozone standard is 0.12 parts per million (ppm). This level is not to be exceeded more than three times within any three year period. Ozone levels at the downtown San Jose monitoring station exceeded the federal 1-hour ozone standard twice in 1995B1999 (Table A-3). This was not in violation of federal standards, although the greater Bay area is currently in non-attainment with regard to the federal 1-hour standard. The state 1-hour ozone standard is more stringent than the federal standard. It limits ozone concentrations to 0.09 ppm, not to be exceeded at any time. Ozone levels at the downtown San Jose monitoring station exceeded the state 1-hour ozone standard a total of 23 times in 1995-1999 (Table A-3).

A new federal 8-hour ozone standard is more stringent than the current 1-hour federal standard, which will be phased out gradually. The 8-hour ozone standard is 0.08 ppm. Ozone levels at the downtown San Jose monitoring station exceeded the federal 8-hour standard four times in 1995-1999. However, air quality data for the downtown San Jose monitoring station show a decline in the number of days per year that ozone levels exceeded state and federal standards between 1995 and 1999 (Table A-3).

A.6.4.2 Particulate Matter

Regulation of particulate matter is based on human health risks associated with the inhalation of particles and centers on those that are small enough to reach the lungs when inhaled. Inhalation of particulate matter can cause respiratory problems and interfere with respiratory tract clearing, so that adsorbed toxic substances may be carried throughout the body. The majority of particles that reach the lungs are less than or equal to (≤) 10 microns in size; particulate matter in this size range is referred to as PM10.

The federal 24-hour PM10 standard is 150 micrograms per cubic meter and the state 24-hour standard is 50 micrograms per cubic meter. Federal 24-hour standards may not be exceeded more than once a year. The state 24-hour standards may never be exceeded. PM10 levels at the downtown San Jose monitoring station did not exceed the federal 24-hour standard in 1995-1999. However, the state 24-hour standard was exceeded thirteen times in 1995-1999 at the downtown San Jose monitoring station (Table A-3).

The federal annual PM10 standard is 50 micrograms per cubic meter as an annual arithmetic mean, and the state annual PM10 standard is 30 micrograms per cubic meter as an annual geometric mean. The federal and state annual averages may never be exceeded. PM10 levels at the downtown San Jose monitoring station did not exceed the federal annual PM10 standard in1995-1999. The highest arithmetic mean during these years was 26 micrograms per cubic meter. Likewise, the state annual PM10 standard was not violated at the downtown San Jose monitoring station in 1995-1999. The highest geometric mean during these years was 24 micrograms per cubic meter (Table A-3).

Overall, air quality data for the San Jose region show a decline in the number of days per year that PM10 levels exceeded state and federal standards between 1995 and 1999 (Table A-3).

New federal 24-hour and annual arithmetic mean standards for particulate matter with a diameter ≤ 2.5 microns (PM2.5) have been established to further reduce the amount of particulate matter in ambient air. The new 24-hour PM2.5 standard is 65 micrograms per cubic meter, and the new annual arithmetic mean PM2.5 standard is 15 micrograms per cubic meter.

A.6.4.3 Carbon Monoxide

Carbon Monoxide (CO) is produced almost entirely by automobiles. CO exposure can cause chest pains in heart patients. It can also lead to headaches, reduced mental alertness, and even death at high levels of inhalation.

Both federal and state standards for CO levels exist. The federal and state 8-hour CO standard is 10 milligrams per cubic meter. The federal 1-hour CO standard is 40 milligrams per cubic meter and the state 1-hour CO standard is 23 milligrams per cubic meter. Neither the 8-hour nor the 1-hour state standard may be exceeded. The federal 8-hour and 1-hour standards may not be exceeded more than once per year. CO levels at the downtown San Jose monitoring station did not exceed either state or federal standards on any day during 1995-1999 (Table A-3).

A.6.4.4 Nitrogen Dioxide

Nitrogen dioxide (NO_2) is the most abundant of the oxides of nitrogen that are often referred to collectively as NO_x. In high concentrations, NO_2 can cause breathing difficulties. High NO_2 concentrations occur in areas with combustion sources such as motor vehicle engines, power plants, and refineries. The Recon Study Area and surrounding region are designated as an attainment area for state NO_2 standards and as an unclassified/attainment area for federal standards. NO_2 levels at the downtown San Jose monitoring station did not exceed either state or federal standards on any day during 1995-1999 (Table A-3).

A.6.4.5 Sensitive Receptors

Sensitive receptors are facilities in which populations who are sensitive or susceptible to detrimental health effects caused by air pollutants live or work. Sensitive populations include senior citizens, children, and the acutely and chronically ill. The Recon Study Area contains residential neighborhoods and an elementary school that are classified as sensitive receptor sites.

A.6.4.6 Toxic Air Contaminant (TAC) Locations

The BAAQMD has identified three sites within the Recon Study Area as Toxic Air Contaminant (TAC) locations. The Newby Island Landfill operation, the San Jose/Santa Clara Water Pollution Control Plant, and the Zanker Road landfill are all considered major emitting sources within the Recon Study Area (Figure A-3). None of these is considered a threat to public health. Thus the BAAQMD is not required to make any public notification under the Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB-2588). However, the BAAQMD is responsible for responding to air pollution complaints under California's public nuisance law. Under the California Health and Safety Code, Section 41700, a public nuisance is defined as a "discharge of air contaminants that cause injury, detriment, nuisance or annoyance to any considerable number of persons". The residents of Alviso have complained about the odor from the San Jose/Santa Clara Water Pollution Control Plant, the local landfills, and the infrastructure and agricultural land uses in the area. The BAAQMD defines the "considerable number of persons" as five individual complaints from five separate residences regarding one site within the same day. When this occurs, a formal violation is issued to the responsible source by an inspector. The responsible parties must then take corrective action, and pay the ordered penalty.

A.7 WATER QUALITY

Quantitative water quality data for the Recon Study Area are very limited. This discussion includes information on water quality in upstream areas where it is better documented. Water quality in upstream areas is one influence on downstream water quality.

In bay marsh environments, like those of the Recon Study Area, the most basic indicator of water quality is salinity, which is related to the mixture of freshwater and seawater, and dictates which organisms can survive in various habitats. Other indicators of water quality include the concentrations of suspended solids, chlorophyll *a*, and dissolved oxygen. In the San Francisco Bay area, all of these indicators are greatly influenced by variations in freshwater flows into the Bay (Cloern et al. 2000).

Approximately 90% of the Recon Study Area is occupied by salt evaporation ponds. The primary factor influencing water quality in these ponds is salinity. Salinities range from 80 to 190 parts-per-thousand (ppt). During summer, when streamflows are minimal and there is little rainfall runoff to dilute pollutants that enter the stream channel, other important water-quality parameters include temperature, dissolved oxygen content, turbidity, and concentrations of coliform bacteria, ammonia, and biostimulatory nutrients such as nitrogen and phosphorus. Nuisance conditions such as algal growth and odors may be related to these first-order controls, and may in turn influence the usability of water by fish and wildlife. During winter, when streamflow is much greater, the quality of flows discharging into the Recon Study Area is strongly influenced by storm-induced transport of pollutants. These include: sediments from erosion of natural soils and construction site materials; oils and grease from automobiles and paved areas; and nutrients from agricultural fields, livestock waste, and organic litter (e.g., leaves, grass clippings) (Santa Clara Valley Water District and U.S. Army Corps of Engineers 1998).

Many trace metals and organic compounds can be toxic to aquatic organisms if they are present in sufficiently high concentrations. However, the solubility of these compounds in water is low and they are therefore generally present only in very small concentrations. Water-quality analyses have demonstrated the presence of mercury, lead, copper and zinc in waters of the Guadalupe River (Santa Clara Valley Water District and U.S. Army Corps of Engineers 1998). The New Almaden Quicksilver Mine, which operated for many years in the upper watershed, is one source of the mercury that is now endemic in the river system (U.S. Amy Corps of Engineers and Jones & Stokes 1999); this issue is discussed in greater detail below.

The federal Clean Water Act (CWA) established programs and requirements aimed at improving and maintaining water quality. Section 303(d) of the CWA requires each state to prepare a list of its waters (rivers, lakes, etc.) that are impaired, or fail to meet water-quality standards with regard to specific water-quality parameters. Section 303(d) also requires the establishment of Total Maximum Daily Loads (TMDLs) for those waters identified by the State as impaired, where traditional local controls have not resulted in full compliance with the standards. A TMDL can be regarded as a quantitative assessment of a water quality problem. TMDLs may address pollutant concentrations (e.g., concentrations of heavy metals or pesticides) or physical properties of the water such as dissolved oxygen content or temperature. A TMDL specifies the total "load" of each pollutant permitted in an impaired water body and limits the contribution of the pollutant allowed from known individual sources.

In May of 1998, as required by Section 303(d) of the CWA, the California State Water Resources Control Board (SWRCB) submitted to the U.S. Environmental Protection Agency its most recent list of impaired water bodies in California. A revised list is scheduled for submittal in May 2000. A number of bodies of water within the Guadalupe River watershed are included on SWRCB's 1998 303(d) list as impaired, including southern San Francisco Bay, Calero Reservoir, Guadalupe Reservoir, Alamitos Creek, Guadalupe Creek, and the Guadalupe River. Table A-5 lists impaired waters in the Guadalupe River watershed and the pollutant which led to the designation. TMDL programs will be required for these impaired waters; the programs are now in various stages of development.

As Table A-5 shows, mercury contamination is a widespread problem within the Guadalupe watershed system. This is in large part a legacy of the California gold-mining era, when cinnabar and other mercury ores were mined in the hills surrounding the Guadalupe River watershed to produce mercury needed in the gold refining process. The New Almaden Mine complex was the largest of the Bay area's mercury mines and was operated intermittently between 1854 and 1976. The mine area drains to Los

Table A-5. Impaired Waters in Guadalupe River Watershed (SWRCB 1998).

Water Body/Waterway	Listed Impairment (Pollutant)
San Francisco Bay, south	Copper Mercury Nickel Selenium Diazinon PCBs Exotic Species
Calero Reservoir	Mercury
Guadalupe Reservoir	Mercury
Alamitos Creek	Mercury
Guadalupe Creek	Mercury
Guadalupe River	Mercury

Capitancillos Creek, Almaden Reservoir, Guadalupe Reservoir, Guadalupe Creek, and Alamitos Creek (RWQCB 1998a). The New Almaden Mine is located on lands now owned by the Santa Clara County Parks and Recreation Department and is surrounded by Almaden Quicksilver County Park, which has an area of approximately 4,000 acres. Additional mines in the vicinity include the Guadalupe Mines, adjacent to Guadalupe Creek at the Guadalupe Landfill (RWQCB 1998a). Leaching of tailings, combined with overland and stream channel transport of mercury-rich tailings and mercury-contaminated soils, has resulted in the downstream accumulation of mercury in the Guadalupe River watershed.

An updated 303(d) list for California is scheduled for release in 2002. It may include a siltation listing for the Guadalupe River and a Polycyclic Aromatic Hydrocarbons (PAH) listing for south San Francisco Bay. A task force is currently studying the effects of nickel and copper in south San Francisco Bay. Based on their preliminary findings, the RWQCB may de-list the South Bay as impaired for nickel and copper.

A.8 BIOLOGICAL RESOURCES

This section describes the biological resources of the Recon Study Area. Information provided in this section is based on existing data including previous surveys and published reports and maps. Plant communities and unvegetated habitats are described first, followed by special-status plants, common fish and wildlife, and special-status wildlife. Refer to Figures A-6 and A-7 which map habitat and wildlife resources in the area.

The Recon Study Area contains a wide variety of plant communities characteristic of upland, wetland, and riparian habitats over much of the southern San Francisco Bay area. These include: ruderal areas, non-native annual grasslands, agricultural lands, salt ponds, tidal salt marshes, diked salt marshes, brackish marshes, freshwater marshes, seasonal wetlands, and enhanced and constructed wetlands, as well as narrow corridors of natural cottonwood-willow riparian forest and woodland, and riparian revegetation sites. Most of the area's habitats, both uplands and wetlands, have experienced some degree of anthropogenic disturbance. Nonetheless, the area supports populations of at least two special-status plant species (Congdon's tarplant and marsh gumplant), and offers suitable habitat for several others (California sea-blite, hairless popcornflower, and Point Reyes bird's beak).

Because detailed field surveys have never been performed for some species groups in some habitats (e.g., birds in the area's saltponds), and for others (e.g., reptiles, mammals) across the entire area, data on animal use of the Recon Study Area are incomplete. However, it is clear that the area offers significant habitat value to a large and diverse assemblage of animal species. Many invertebrates and fish are resident in the area's salt ponds, and large numbers of birds forage, roost, bathe and nest in and around them. Ponds A5 and A6 are the nesting site for the largest California gull colony in San Francisco Bay and are the only Bay Area site where the Caspian tern breeds. Both tidal and non-tidal wetlands also support a variety of birds and are an important link in the migratory route of native anadromous fishes such as steelhead trout and chinook salmon. Even the area's more disturbed upland habitats provide foraging opportunities and cover for raptors, passerine birds, and small mammals.

The Recon Study Area supports resident and breeding populations of several special-status animal species. These include steelhead trout, chinook salmon, California clapper rail, Western snowy plover, California least tern, burrowing owl, loggerhead shrike, salt marsh common yellowthroat, salt marsh harvest mouse, and possibly also tricolored blackbird and Alameda song sparrow. Other special-status species use habitats in the Recon Study Area for foraging during migration.

A.8.1 PLANT COMMUNITIES

The Recon Study Area supports a wide variety of vegetation types characteristic of upland, wetland, and riparian habitats over much of the southern San Francisco Bay area. Most of the upland habitats in the Recon Study Area have been disturbed in some way; disturbed areas generally support ruderal and non-native grassland species. Many ruderal areas and non-native grasslands occur in abandoned agricultural fields, railroad right-of-ways, or vacant lots. Wetland areas include freshwater marshes, brackish marshes, seasonal wetlands, diked salt marshes, and salt ponds. Riparian portions of the study area include native stands of cottonwood-willow riparian forest and riparian revegetation sites. The Recon Study Area also includes developed areas, which typically support introduced ornamental and ruderal species.

This report relied on several sources to establish baseline vegetation conditions in the Recon Study Area. The Alviso Master Plan, Volume II, Technical Appendices (City of San Jose 1998d) describes vegetation in the Alviso area. The environmental impact report prepared in conjunction with the Alviso Master Plan (City of San Jose 1998c) describes vegetation of the landfills in the Recon Study Area. Information on the individual marshes in the Recon Study Area was drawn from a California clapper rail breeding survey performed by H.T. Harvey & Associates (H.T. Harvey & Associates 1989).

Figure A-6 shows the distribution of different types of habitat and vegetation in the Recon Study Area. Specific types of habitat shown on Figure A-6 include: developed areas, ruderal areas and areas of non-native grassland, disturbed areas, agricultural lands, wetlands (including salt ponds, tidal salt marshes, diked salt marshes, brackish marshes, freshwater marshes, seasonal wetlands, and constructed wetlands), open water, and riparian forest/woodland. These habitat types are described individually below.

A.8.1.1 Unvegetated Areas and Areas of Non-Native Vegetation

Developed Areas

The developed portions of the Recon Study Area include residential and urban development. On these lands ornamental trees and shrubs, weedy grasses, and forbs have replaced native vegetation. Common ornamental plants on developed lands include the Monterey pine (*Pinus radiata*), Mexican fan palm (*Washingtonia robusta*), deodar cedar (*Cedrus deopdora*), coast redwood (*Sequoia sempervirens*), sweetgum (*Liquidambar styraciflua*), firethorn (*Pyracantha* sp.), oleander (*Nerium oleander*), and juniper (*Juniperus* sp.).

Ruderal Areas, Non-Native Grasslands, and Disturbed Areas

Ruderal and non-native grassland areas in the Recon Study area include abandoned agricultural fields and other disturbed areas such as landfills, railroad right-of-ways, vacant lots, and areas where imported fill has recently been disked or scraped. (Note that ruderal areas and areas of non-native grassland vegetation are distinguished from disturbed areas on Figure A-6.) For example, the area east of North First Street is composed of former croplands that have reverted to ruderal grasslands. The disturbed areas between North First Street and the Guadalupe River, and the grasslands between the Guadalupe River and Gold Street, both support ruderal and non-native grasses. The Recon Study Area encompasses three active landfills and a number of inactive landfills. The active landfills are located in the southern sections of the Owens-Corning and Zanker Road Landfill properties (see Figures A-3 and A-6), and in the northeast portion of the study area on Newby Island. The inactive landfills support ruderal and non-native grasslands; the active landfills for the most part remain unvegetated.

Common plants in ruderal/non-native grassland areas include ripgut brome (*Bromus diandrus*), hare barley (*Hordeum murinum* ssp. *leporinum*), hairy wild oats (*Avena barbata*), soft chess (*Bromus hordeaceus*), smilo grass (*Piptatherum miliaceum*), bur clover (*Medicago polymorpha*), Russian thistle (*Salsola tragus*), bristly ox-tongue (*Picris echioides*), yellow star-thistle (*Centaurea solstitialis*), horseweed (*Conyza canadensis*), and wild radish (*Raphanus sativus*). Mediterranean barley (*Hordeum marinum* ssp. *gussoneanum*), Italian ryegrass (*Lolium multiflorum*), and common beet (*Beta vulgaris*) are common in areas between non-native grasslands and seasonal wetlands. Weedy grasses and forbs that are common to railroad lands and vacant lots include hare barley, rat-tail fescue (*Vulpia myuros*), smilo grass, cheeseweed (*Malva parviflora*), and sweet fennel (*Foeniculum vulgare*).

Agricultural Lands

Agricultural lands are found in the southeast corner of the Recon Study Area, west of Coyote Creek and north of Highway 237, between Grand Boulevard and Nortech Avenue. Crops include oats (*Avena sativa*) and barley (*Hordeum vulgare*) as well as truck crops such as bell peppers (*Capiscum* sp.), lettuce (*Lactuca sativa*), and cucumbers (*Cucurbita pepo*). Native plants generally do not occur in agricultural areas. Disturbed portions of agricultural lands commonly support ruderal vegetation, as described above.

A.8.1.2 Wetlands

Historically, most of the Recon Study Area consisted of extensive and continuous wetland. Close to San Francisco Bay, the wetlands were strongly influenced by the daily tides and supported species adapted to a brackish or saltwater environment. Near the mouths of Coyote Creek, the Guadalupe River, and other watercourses, wetlands were more strongly influenced by fresh water, and thus supported freshwater wetland vegetation. Between the Bay and the river mouths, saltwater and freshwater mixed to create brackish marshes.

Today, the majority of the former marsh has been converted to commercial salt ponds. Other areas have been diked but still support wetland vegetation. The original patchwork of salt, brackish, and freshwater marsh is still present along remnant sloughs such as Guadalupe Slough, Alviso Slough, and Coyote Creek/Coyote Slough. Figure A-6 shows the areal distribution of the Recon Study area's marsh habitats and their associated dominant plant species, based on mapping conducted in September 1999 with color infrared digital orthophoto images as a base (H.T. Harvey & Associates 1999a).

Salt Ponds

Cargill owns and maintains several thousand acres of salt evaporation ponds in southern San Francisco Bay. Salt ponds make up approximately 90% of the Recon Study Area. Salt water from San Francisco Bay is impounded in the ponds, which are separated by levees that follow the contours of the landscape. Water is moved from pond to pond as salinity increases via evaporation; salt is eventually scraped from the crystallizer beds and refined for sale and use. The salt ponds thus have surface waters with a wide range of salinities: salinity depends on a pond's particular location in the salt concentrating process. The ponds are generally unvegetated with the exception of algae, primarily stringy green algae belonging to genus *Enteromorpha*. The salt ponds west of Alviso Slough and east of Guadalupe Slough (ponds A5–A8) are referred to herein as the "Knapp ponds," while the ponds east of Alviso Slough and west of Artesian Slough (ponds A9–A15) are referred to as the "Alviso ponds" (Figure A-6 and Table A-6).

Water from San Francisco Bay flows into the salt pond complex at two locations. One point of entry is the mouth of Charleston Slough, which lies west of the Recon Study Area, and outside the area shown in Figure A-6. Via Charleston Slough, water is channeled into pond A1 at the westernmost edge of the complex. (Ponds A1–A4 are also outside the Recon Study Area and are not labeled on Figure A-6). The second location where bay water enters the complex is the mouth of Alviso Slough, where water is channeled directly into pond A9. In addition, water from Charleston Slough flows east from pond A1 to pond A8, and then is pumped under Alviso Slough into pond A11. In pond A11, the Charleston Slough water mixes with water that enters the pond complex from Alviso Slough, and the mixed water then flows east.

Various studies have shown that pond salinity and depth are the most important factors controlling the types of animal communities present in the ponds of the Recon Study Area (e.g., Carpelan 1957, Summers et al. 1981, Lonzarich 1989). In particular, Carpelan (1957) recorded salinities during 1951 in the Knapp ponds (A5–A8). Lonzarich (1989) later recorded salinities during 1985–1986 in the Alviso ponds (A9–A15).

The work of Carpelan (1957) and Lonzarich (1989) provides this report's baseline dataset on salinities in the salt evaporation ponds (Table A-6). These studies showed that mean annual salinities in ponds A9 and A10 are the lowest, ranging from 20 to 40 parts per thousand (ppt) dissolved salts and averaging 30 ppt (the salinity of seawater is approximately 35 ppt). Salinities in ponds A5–A7 are moderate, ranging from 50 to 86 ppt and averaging 64 ppt; during the Carpelan (1957) study, the area that is now divided into ponds A5–A7 was a single large pond. Salinities in pond A8 are higher, ranging from 61 to 153 ppt and averaging 94 ppt. Finally, salinities in ponds A11–A15 are moderate. Mean salinities in these ponds range from 23 to 84 ppt; the average mean salinity in ponds A11–A15 is 50 to 68 ppt. Thus, the introduction of high-salinity water from pond A8 into pond A11 (which also receives water from pond A10) causes a dramatic increase in pond A11's salinity. This is especially evident when pond A11's salinities are compared to those of ponds A9–A10, which contain water that has just entered the salt pond complex from San Francisco Bay (see discussion above and Figure A-6).

Lonzarich (1989) measured water depths in the Alviso ponds, with the exception of pond A14; water depths for the Knapp ponds are not available (Table A-6). Among the Alviso ponds, Lonzarich's work showed that pond A9 is the deepest, although it shows a seasonal depth variation of about 125 cm (4.1 feet), and much of its northeastern portion is very shallow. The depth of pond A15 is a steady 75 cm (2.5 feet) while that of ponds A10–A13 varies considerably between 25 cm (0.8 foot) and 75 cm (2.5 feet), averaging about 60 cm (2.0 feet). Water depth is generally lowest during summer and fall, and highest during winter and spring (Lonzarich 1989).

Lonzarich (1989) found that vegetation in the salt ponds is dominated by microscopic stringy green algae belonging to the genus *Enteromorpha*; members of the similar genus *Ulva* are present but are less abundant. *Enteromorpha* is most abundant in ponds A9 and A10, which have an average cover of 40% and 12%, respectively, during summer and fall. Average winter and spring surface cover in these ponds is about 50% of the summer value. In high-salinity ponds, *Enteromorpha* is less abundant, or is absent altogether (Lonzarich 1989) (Table A-6).

Table A-6. Pond Salinities in the Recon Study Area

Tidal Salt Marsh

Tidal salt marsh habitat is located along the lower portions of Alviso Slough, Guadalupe Slough, and Coyote Creek between the levees of the salt evaporation ponds and the slough channels (Figure A-6). The dominant plant species of this habitat type are pickleweed (*Salicornia virginica*), cordgrass (*Spartina foliosa*), and saltgrass (*Distichlis spicata*). A few small patches of alkali bulrush (*Scirpus robustus*) occur within this zone as well.

Diked Salt Marsh

Diked salt marsh refers to areas of salt marsh without tidal action or with regulated tides. New Chicago Marsh is a large area of diked salt marsh; tidal influence on the marsh is regulated by the New Chicago Marsh canal that connects with Coyote Creek. In order to periodically flush New Chicago Marsh, the U.S. Fish and Wildlife Service opens the tide gate to the marsh in mid- or late May. The gate remains open until the rainy season begins, normally in late October or early November, but the amount of tidal water that enters New Chicago Marsh does not keep pace with evaporation, so the marsh is never fully flushed. In addition to New Chicago Marsh, there are also small areas of diked salt marsh along the Guadalupe River and west of Spreckels Avenue.

The diked salt marsh habitat supports a wide variety of vegetation. The composition and quality of the vegetation is variable throughout the area, ranging from relatively pure stands of salt marsh species, including pickleweed, alkali heath (*Frankenia salina*), and salt grass to mixed salt marsh/grassland areas supporting pickleweed and annual grasses such as rabbitsfoot grass (*Polypogon monspeliensis*), Italian ryegrass, and Mediterranean barley.

Brackish Marsh

Brackish marsh habitat is the most common wetland habitat of southern San Francisco Bay. Brackish marsh habitat is found in most of Alviso Slough, Guadalupe Slough, and Artesian Slough and along Coyote Creek from the eastern edge of the study area to the vicinity of Goose Point (Figure A-6). Intertidal areas along the Guadalupe River and San Tomas Aquinas Creek also support brackish marsh vegetation from the lower channel banks partway up the levee slopes. The dominant plant species of the brackish marsh habitat are generally alkali bulrush, California bulrush (*Scirpus californicus*), and perennial peppergrass (*Lepidium latifolium*). Small patches of pickleweed and spearscale (*Atriplex triangularis*) also occur within this zone. Triangle Marsh, west of Artesian Slough, is a large area consisting almost entirely of brackish marsh. It supports primarily alkali bulrush, with some Pacific cordgrass, perennial peppergrass, pickleweed, and alkali heath. The Coyote Slough Marsh, located east of Artesian Slough, contains a large area of brackish marsh that is dominated by alkali bulrush, but also supports peppergrass and California bulrush. The Alviso Slough Marsh, located about 3.5 kilometers upstream from the mouth of Alviso Slough, supports a mixture of pickleweed and alkali bulrush, with small areas of cordgrass.

Freshwater Marsh

Freshwater marsh habitat is present in Alviso Slough/Guadalupe River, near the Gold Street Bridge, and in the southern (upstream) half of Artesian Slough (Figure A-6). The dominant plant species of the freshwater marsh habitat are California bulrush, tule (*Scirpus acutus*), alkali bulrush, and cattail (*Typha* spp.).

Seasonal Wetland

The southeastern portion of the Recon Study Area contains scattered patches of seasonal wetland habitat. Seasonal wetlands occur in depressions and swales within all types of upland habitats, including agricultural lands, non-native grasslands, and disturbed areas. However, the full extent of seasonal wetlands in the Recon Study area is unknown. Figure A-6 indicates areas that may contain seasonal wetlands, based on examination of aerial photography reproduced in the Alviso Master Plan (City of San Jose, 1998a).

Seasonal wetlands support a variety of freshwater wetland vegetation such as broadleaf cattail and smaller herbaceous species including rabbitsfoot grass and curly dock (*Rumex crispus*). In more saline areas common species include pickleweed, Australian saltbrush (*Atriplex semibaccata*), spearscale, and ruderal vegetation.

Enhanced and Constructed Wetlands

In the southwestern portion of the study area, between San Tomas Aquinas and Calabazas creeks, enhanced and constructed wetlands and ponds predominate. These wetland areas represent mitigation sites for the effects of constructing Highway 237. Constructed wetlands are also found in the northern section of the Zanker Road Landfill.

Enhanced or constructed wetlands include areas that are seasonally or perennially ponded as well as mud flats and salt plains. Vegetation within the emergent marsh areas includes broadleaf cattail (*Typha latifolia*) and California bulrush. Pickleweed is found on the edges of marsh regions, and ruderal vegetation occurs on the banks of the levees that border these wetland areas.

A.8.1.3 Open Water

Areas of open water occur throughout the Recon Study Area. Open water is found in San Francisco Bay, in the slough channels, and in creek and river channels. Open water is also present in the ponds of the San Jose/Santa Clara Water Pollution Control Plant in the eastern portion of the study area and in the portion of the Sunnyvale Water Treatment Plant pond included in the southwestern portion of the Recon Study Area.

A.8.1.4 Riparian Vegetation

Cottonwood Riparian Forest and Woodland

Cottonwood riparian forest and woodland occurs in the northeastern portion of the Recon Study Area along Coyote Creek. It is dominated by Fremont cottonwood (*Populus fremontia*), blue elderberry (*Sambucus mexicana*), box elder (*Acer negundo*), California black walnut (*Juglans californica* var. *hindsii*), and arroyo willow (*Salix lasiolepis*). In the understory and in open areas, coyote brush (*Baccharis pilularis*), California blackberry (*Rubus ursinus*), creeping wild rye (*Leymus triticoides*), and non-native grasses are also found.

Riparian Revegetation Sites

Two major riparian revegetation sites are located within the Recon Study Area. The first site is located along a levee road east of the Coyote Creek Riparian Station (Figure A-6). Tree and shrub species found in this area include Fremont cottonwood, western sycamore (*Platanus racemosa*), red willow (*Salix laevigata*), box elder, coast live oak (*Quercus agrifolia*), blue elderberry, and coyote brush. The second site, which is located along the Coyote Creek riparian corridor, supports the same tree species but in smaller numbers.

Two smaller revegetation areas are located farther downstream on Coyote Creek (Figure A-6). They support Fremont cottonwood, red willow, box elder, blue elderberry, coyote brush, California rose (*Rosa californica*), California sagebrush (*Artemisia californica*), and Brewer's saltbrush (*Atriplex lentiformis* ssp. *lentiformis*).

A.8.2 SPECIAL-STATUS PLANTS

Several plant species that occur in the Recon Study Area have been given special status under federal or state endangered species legislation, or through the California Native Plant Society (CNPS) or Natural Diversity (NDDB) databases. The following sections provide information on special-status plant species that occur, or may occur, in the Recon Study Area. Table A-7 summarizes special-status plant species found within the study area or in close proximity to the study area. Information in Table A-7 is drawn from Natural Diversity Data Base records for the Hayward, Milpitas, Montara Mountain, Mountain View, Newark, Niles, Palo Alto, Redwood Point, Richmond, San Leandro, and San Mateo 7.5′ quadrangles (California Department of Fish and Game 2000), the CNPS database (Skinner and Pavlik 1994), reports of surveys in the area (H.T. Harvey & Associates 1999a) and summaries of surveys in the area (City of San Jose 1998d).

A.8.2.1 California Sea-Blite (Suaeda californica)

California sea-blite is federally listed as endangered and is on CNPS List 1B. It is a perennial shrub with succulent leaves and is generally found on the upper margins of coastal salt marshes. It flowers between July and October. California sea-blite historically occurred in salt marshes from the San Francisco Bay Area south to Morro Bay near San Luis Obispo (Skinner and Pavlik 1994). It now occurs only in Morro Bay and is thought to be extirpated from the San Francisco Bay Area. The last reported sightings of this species in the Bay Area were in Alameda County near San Leandro in 1958 and in Santa Clara County on salt flats near the Palo Alto Yacht Harbor in 1971. Within the Recon Study Area, the tidal marshes bordering Coyote Creek, Alviso Slough, and Guadalupe Slough contain suitable habitat for this species. However, because the species is likely extirpated from San Francisco Bay, it is not expected to occur in the Recon Study Area.

A.8.2.2 Congdon's Tarplant (Hemizonia parryi ssp. congdonii)

Congdon's tarplant is a federal species of concern and is on CNPS List 1B. It is an annual herb, generally found in alkaline valley and foothill grassland habitats. It blooms from June through November. Congdon's tarplant is found in Alameda, Contra Costa, Monterey, Santa Clara, and San Luis Obispo counties (Skinner and Pavlik 1994). It is thought to be extirpated from Santa Cruz and Solano counties. This species was rediscovered in Santa Clara County in 1998. There are confirmed populations of this species at several sites in the Recon Study Area, including vacant lots in Alviso and the Cisco property. Suitable habitat for this species is present in the ruderal areas and non-native grasslands throughout the southeastern portion of the Recon Study Area.

A.8.2.3 Delta Tule Pea (Lathyrus jepsonii ssp. jepsonii)

Delta tule pea is a federal species of concern and is on CNPS List 1B. It is a perennial trailing vine commonly found in fresh and brackish marshes. Its flowering period ranges from May through September. Populations of the Delta tule pea are found in various regions of California north of the project area; the closest known population is located nearly 45 miles north of the Recon Study Area in Southampton Marsh, northwest of Benicia. The Recon Study Area is outside the known geographic range of the species.

A.8.2.4 Hairless Popcornflower (Plagiobothrys glaber)

Hairless popcornflower is on CNPS List 1A and is thought to be extinct. It was a succulent annual found historically in alkaline meadows and coastal marshes in and around San Francisco Bay. Its flowering period ranged from March through May. Salt marshes in the area bordering Coyote Creek and seasonal wetlands within the Recon Study Area offer suitable habitat for this species.

Table A-7. Special-status Plants

Common Name Scientific Name	Status* Fed/State/CNPS	California Distribution (Counties)	Habitats	Flowering Period	Potential for occurrence in project area
Alkali milk vetch *Astragalus tener* var. *tener*	–/–/1B	Merced, Napa, Solano, and Yolo; presumed extirpated in Alameda, Contra Costa, Monterey, San Benito, San Francisco, San Joaquin, Santa Clara, Sonoma, and Stanislaus.	Playas, alkaline valley and foothill grasslands (on adobe clay substrate), alkaline vernal pools. Elevation: 1–60 m.	March though June	No records of species in Recon Study Area. Suitable habitat may be present in southeastern portion of Recon Study Area.
California sea-blite *Suaeda californica*	E/–/1B	San Luis Obispo; presumed extirpated in Alameda and Santa Clara.	Coastal marshes. Elevation: 0–5 m.	July through October	No records of species in Recon Study Area. Highly unlikely to occur; thought to be extirpated from San Francisco Bay Area.
Caper-fruited tropidocarpum *Tropidocarpum capparideum*	SOC/–/1A	Presumed extinct (presumed extirpated in Alameda, Contra Costa, Glenn, Monterey, Santa Clara, and San Joaquin).	Alkaline valley and foothill grasslands. Elevation: 1–455 m.	March through April	No records of species in Recon Study Area. Highly unlikely to occur; presumed extinct.
Congdon's tarplant *Hemizonia parryi* ssp. *congdonii*	SOC/–/1B	Alameda, Contra Costa, Monterey, San Luis Obispo, and Santa Clara; presumed extirpated in Santa Cruz and Solano.	Alkaline soils of valley and foothill grasslands. Elevation: 1–215 m.	June through November	Occurs on vacant lots in Alviso and on ruderal grassland on Cisco property. Suitable habitat present in ruderal grasslands throughout southeastern portion of Recon Study Area.
Contra Costa goldfields *Lasthenia conjugens*	E/–/1B	Alameda, Contra Costa, Monterey, Napa, and Solano; presumed extirpated in Mendocino, Santa Barbara, and Santa Clara.	Cismontane woodlands, alkaline playas, alkaline valley and foothill grasslands, mesic vernal pools. Elevation: 0–470 m.	March through June	No records of species in Recon Study Area. Suitable habitat may occur around seasonal freshwater wetlands.
Delta tule pea *Lathyrus jepsonii* var. *jepsonii*	SOC/–/1B	Alameda, Contra Costa, Fresno, Marin, Napa, Sacramento, San Benito, Santa Clara, San Joaquin, and Solano.	Fresh and brackish marshes. Elevation: 0–4 m.	May through September	No records of species in Recon Study Area. Suitable habitat may be present.
Hairless popcornflower *Plagiobothrys glaber*	–/–/1A	Presumed extinct (presumed extirpated in Alameda, Marin, Merced, San Benito, and Santa Clara).	Alkaline meadows, coastal marshes. Elevation: 15–180 m.	March through May	No records of species in Recon Study Area. Highly unlikely to occur; presumed extinct.
Marsh gumplant *Grindelia stricta* var. *angustifolia*	–/–/4	Alameda, Contra Costa, Marin, Monterey, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma.	Coastal marshes. Elevation: 0–10 m.	August through October	Occurs at upper margin of marsh throughout tidal and diked salt marshes of Recon Study Area.

Point Reyes bird's beak *Cordylanthus maritimus* ssp. *palustris*	SOC/–/1B	Humboldt, Marin, and Sonoma; presumed extirpated in Alameda, San Mateo, and Santa Clara.	Coastal salt marshes. Elevation: 0–10 m.	June through October	Specimen in 1905 collection of species was likely taken from a site within the Recon Study Area; precise location is unknown. Suitable habitat present in salt and brackish marshes throughout Recon Study Area.
Robust spineflower *Chorizanthe robusta* var. *robusta*	SOC/–/1B	Monterey and Santa Cruz; presumed extirpated in Alameda, San Mateo, and Santa Clara.	Cismontane woodlands, coastal dunes, coastal scrub. Elevation: 3–120 m.	May through September	No records of species in Recon Study Area. Suitable habitat may be present. Highly unlikely to occur; thought to be extirpated from San Francisco Bay Area.
San Francisco Bay spineflower *Chorizanthe cuspidata* var. *cuspidata*	SOC/–/1B	Marin, San Francisco, San Mateo, Santa Clara and Sonoma; presumed extirpated in Alameda.	Coastal bluff scrub, coastal dunes, coastal prairie, coastal scrub. Elevation: 5–550 m.	April through August	No records of species in Recon Study Area. Suitable habitat may be present.
San Joaquin spearscale *Atriplex joaquiniana*	SOC/–/1B	Alameda, Contra Costa, Glenn, Merced, Monterey, Napa, Sacramento, San Benito, Solano, and Yolo; presumed extirpated in San Joaquin, Santa Clara, and Tulare.	Chenopod scrub, meadows, playas, alkaline valley and foothill grasslands. Elevation: 1–320 m.	April through October	No records of species in Recon Study Area. Suitable habitat may be present.

A.8.2.5 Marsh Gumplant (Grindelia stricta var. angustifolia)

Marsh gumplant is on CNPS List 4, a watch list. It is a shrub found along the margins of coastal salt marshes in San Francisco, San Pablo, and Suisun bays. The flowering period for this species is from August through October. Common habitat for marsh gumplant is on levee slopes near tidal sloughs and on marsh plains. Marsh gumplant has not been observed in surveys of the lower Recon Study Area and nearby tidal marsh areas adjacent to Coyote Creek (H.T. Harvey & Associates 1994, CH2M Hill 1991, H.T. Harvey & Associates 1989b). However, suitable habitat within the Recon Study Area is presumed to support populations of marsh gumplant.

A.8.2.6 Point Reyes Bird's Beak (Cordylanthus maritimus ssp. palustris)

Point Reyes bird's beak is a federal species of concern and is on CNPS List 1B. It is an annual species found in coastal salt marshes, with a flowering period from June to October. Point Reyes bird's beak is thought to be extirpated from Alameda, Santa Clara, and San Mateo counties. Populations are known to occur in Humboldt, Marin, and Sonoma counties. Only two populations of Point Reyes bird's beak were known from Santa Clara County: both were documented near Palo Alto, in 1900 and 1915 respectively. Within the Recon Study Area, the salt marsh bordering Coyote Creek, Alviso Slough, and Guadalupe Slough is suitable habitat for Point Reyes bird's beak, although it is presumed to be absent from the study area.

A.8.3 FISH AND WILDLIFE

The following sections summarize fish and wildlife use of the Recon Study Area, based on the existing literature (see also Tables A-8, A-9, and A-10). Because detailed field surveys have never been performed for some species groups in some habitats (e.g., birds in salt ponds, common mammals throughout the study area) species groups are not described in equal detail across habitats. However, both invertebrate and vertebrate species are addressed to the extent that data are available. State-listed and federally listed species that occur or may occur in the Recon Study Area are described in detail under "Special-Status Fish and Wildlife Species (appendix section A.8.4)."

A.8.3.1 Upland Habitats

This section presents information on wildlife use of the upland habitats shown in Figure A-6 as Ruderal/Non-Native Grassland, Residential/Developed, Disturbed, and Agricultural. Plant communities in these habitats are discussed previously in "Unvegetated Areas and Areas of Non-Native Vegetation" appendix section (A.8.1.1)."

The Recon Study Area contains a wide range of upland habitat, much of which is disturbed to some degree. Ruderal areas, non-native grassland habitat, and agricultural fields are present along Disk Drive, Nortech Parkway and Zanker Road. Many passerine birds and raptors forage here year-round. In areas where water temporarily ponds, these habitats also provide foraging opportunities for shorebirds, ducks, herons, and gulls during the nonbreeding season. Levee slopes and tops provide some reptile habitat, but it is limited both in areal extent and in quality. The town of Alviso and surrounding grasslands provide better habitat for reptiles. Reptiles documented from the Recon Study Area include Western fence lizard (*Sceloporus occidentalis*), alligator lizard (*Gerrhonotus* spp.), gopher snake (*Pituophis melanoleucas*), racer (*Coluber constrictor*), and common garter snake (*Thamnophis sirtalis*). All are common in the area.

Lands surrounding the WPCP in the southeastern portion of the Recon Study Area in particular are highly disturbed, but are nonetheless heavily used by a diversity of birds. Raptors and passerine birds forage on the WPCP site's barren areas and non-native grasslands, which also provide suitable breeding habitat for burrowing owls. Raptors also forage year-round in the site's agricultural fields. California gulls have been observed foraging within the ponds of the main WPCP complex. Ducks, shorebirds, gulls and terns use

Table A-8. Common Resident Birds Of The Recon Study Area

Open Water

California gull
Ring-billed gull
Western gull
American coot
Double-crested cormorant
Canada goose
Northern shoveler
Mallard
Ruddy duck
Pied-billed grebe

Shoreline

American avocet
Willet
Black-necked stilt
Great egret
Snowy egret
Great blue heron

Riparian Forest and Woodland

Black phoebe
Western scrub jay
American crow
Common raven
American goldfinch
Lesser goldfinch
House finch
California towhee
Song sparrow
Golden-crowned sparrow
White-crowned sparrow
Yellow-rumped warbler
American robin

Upland/Marsh

Brewer's blackbird
Red-winged blackbird
European starling
House sparrow
Red-tailed hawk
White-tailed kite
Northern harrier
Western meadowlark
Tree swallow
Barn swallow

Table A-9. Results of 1989–1990 surveys conducted by San Francisco Bay Bird Observatory at Alviso Slough.[a]

Species	Summer Count	Fall Count
Clark's grebe	0	0.1 (1)
American white pelican	0.2 (4)	0
California brown pelican	0.1 (5)	0
Double-crested cormorant[b]	0.2 (5)	0
Great blue heron	0.2 (4)	0
Great egret[b]	<0.1 (2)	0.1 (1)
Snowy egret[b]	0.7 (5)	0.4 (2)
Black-crowned night heron[b]	<0.1 (1)	0
Mallard[b]	3.4 (20)	0.5 (7)
Northern pintail[b]	<0.1 (2)	0
Gadwall[b]	1.9 (56)	0
Northern shoveller[b]	<0.1 (1)	2.1 (37)
Cinnamon teal[b]	0.1 (4)	0
Green-winged teal	<0.1 (1)	0
Lesser scaup[b]	0.1 (5)	0
Duck spp.	3.9 (80)	0
Virginia rail	0	2.5 (7)
Sora	0.4 (6)	0.3 (2)
American coot[b]	1.2 (7)	18.6 (35)
Common moorhen[b]	0.8 (6)	1.1 (2)
American avocet[b]	19.4 (272)	3.1 (15)
Black-necked stilt[b]	20.4 (327)	2.0 (10)
Killdeer[b]	1.4 (8)	4.4 (15)
Black-bellied plover	<0.1 (1)	1.1 (6)
Semipalmated plover	0.1 (2)	0
Long-billed curlew	1.0 (15)	0.2 (2)
Whimbrel	<0.1 (1)	<0.1 (1)
Marbled godwit	3.4 (43)	1.5 (11)
Long-billed dowitcher	1.9 (18)	0.1 (1)
Short-billed dowitcher	2.7 (15)	0
Dowitcher spp.	9.3 (103)	16.1 (80)
Willet	0.8 (9)	0.8 (4)
Greater yellowlegs	0.4 (7)	0.2 (1)
Lesser yellowlegs	0.1 (3)	0
Yellowlegs spp.	0.2 (3)	0
Dunlin	0.7 (30)	0
Western sandpiper	6.1 (50)	8.4 (35)
Least sandpiper	6.6 (52)	17.8 (61)
Western/least sandpipers	16.2 (80)	91.2 (250)
Wilson's phalarope	1.6 (13)	0
Red-necked phalarope	8.6 (380)	0

Species	Summer Count	Fall Count
Phalarope spp.	13.2 (580)	0
Herring gull	0	0.3 (2)
Western gull[b]	3.9 (73)	2.2 (5)
California gull[b]	9.0 (78)	4.5 (17)
Ring-billed gull	14.9 (45)	48.4 (150)
Mew gull	0	0.1 (1)
Gull spp.	37.3 (1000)	0.3 (5)
Caspian tern[b]	<0.1 (1)	0
Forster's tern[b]	0.3 (8)	0
Turkey vulture	<0.1 (2)	0
Red-tailed hawk	0	0.3 (2)
Northern harrier[b]	0.1 (1)	0.2 (2)
White-tailed kite[b]	<0.1 (1)	<0.1 (1)
Ring-necked pheasant[b]	<0.1 (1)	0
Black phoebe[b]	0.2 (1)	<0.1 (1)
Barn swallow[b]	10.9 (32)	0
Cliff swallow[b]	8.1 (100)	0
Violet-green swallow	0.2 (9)	0
Loggerhead shrike[b]	<0.1 (2)	0
Mourning dove[b]	0.3 (2)	0
Marsh wren[b]	2.9 (26)	1.1 (3)
Brewer's blackbird[b]	0.1 (1)	0.4 (5)
Song sparrow[b]	1.3 (6)	1.5 (3)
Savannah sparrow[b]	0	0.5 (3)
Salt marsh common yellowthroat[b]	0	0.7 (4)
House finch[b]	0.7 (7)	0

[a] – San Francisco Bay Bird Observatory data (San Francisco Bay Bird Observatory 1991). Summer surveys were carried out between 4 June and 20 September; fall surveys were carried out between 24 September and 26 November. Table gives the average number of birds of each counted species (= sum of each year's average count, divided by two), followed by maximum count for the first two survey years (in parentheses).

[b] – Species breeds in Recon Study Area.

Table A-10. Special-Status Animals In The Recon Study Area.

Common Name *Scientific Name*	Status* Fed/State	California Distribution	Habitat	Reason for Decline/Concern	Potential for Occurrence in Recon Study Area
Invertebrates					
Mimic Tryonia (California brackish water snail) *Tryonia imitator*	SC/–	Coastal lagoons from Sonoma County south to San Diego County.	Permanently submerged areas; found on a variety of substrates in a wide range of salinities.	Loss of habitat as a result of dredging and filling; poor water quality.	Found in salt evaporation pond A9 in 1986.
Amphibians					
California red-legged frog Rana aurora draytonii	T/SSC	Coast and coastal mountain ranges of California from Humboldt County south to San Diego County; Sierra Nevada (above 1,000 feet) from Butte to Fresno County.	Permanent and semipermanent aquatic habitats (such as creeks and coldwater ponds) with emergent and submergent vegetation and riparian species along the edges; may estivate in rodent burrows or cracks during dry periods.	Alteration of stream and wetland habitats; historical overharvesting; habitat destruction; competition and predation by non-native fish and bullfrogs.	No recorded observations; unlikely to occur in Recon Study Area because suitable habitat is sparse or absent, and potential predators are abundant.
California tiger salamander Ambystoma californiense	C/SSC	Central Valley, including Sierra Nevada foothills to elevations of approximately 1,000 feet; coastal region from Butte County south to Santa Barbara County.	Larvae use small ponds, lakes, or vernal pools in grasslands and oak woodlands; adults use rodent burrows, rock crevices, or fallen logs for cover and for estivation.	Loss of grasslands, vernal pools, and other wetlands as a result of agricultural development and urbanization.	No recorded observations; unlikely to occur in Recon Study Area because suitable habitat is sparse or absent, and potential predators are abundant.
Foothill yellow-legged frog Rana boylii	SC/SSC	Klamath Range, Cascade Range, northern and southern Coast Ranges, Transverse Ranges; Sierra Nevada foothills (to approximately 6,000 feet) south to Kern County.	Woodland or forest creeks and rivers with rock and gravel substrate and low, overhanging vegetation along the edge; usually found near riffles with rocks and sunny banks nearby.	Reduction of habitat quality as a result of altered stream hydrology; habitat loss as a result of urban development; predation by non-native aquatic fauna.	No recorded observations in Recon Study Area; absent from lower Guadalupe River in 1996 SCVWD surveys. Creeks offer potential habitat.
Western spadefoot toad *Scaphiopus hammondii*	SC/SSC	Sierra Nevada foothills; Central Valley; Coast Ranges; coastal counties in southern California.	Shallow streams with riffles; seasonal wetlands such as vernal pools in annual grasslands and oak woodlands.	Alteration of stream habitats by urbanization and hydroelectric projects; loss of seasonal wetlands and vernal pools.	No recorded observations in Recon Study Area; suitable habitat exists in streams, wetlands, and grassland areas.
Reptiles					
Alameda whipsnake Masticophis lateralis *euryxanthus*	T/T	Valleys, foothills, and low mountains in Alameda and Contra Costa counties.	Oak woodland, northern coastal scrub, or chaparral; requires rock outcrops for cover and foraging.	Limited range and restricted habitat; loss of habitat as a result of urban development; predation by domestic and feral cats.	No recorded observations in Recon Study Area. Recon Study Area is likely outside range of species.

Common Name *Scientific Name*	Status* Fed/State	California Distribution	Habitat	Reason for Decline/Concern	Potential for Occurrence in Recon Study Area
California horned lizard Phrynosoma coronatum *frontale*	SC/–	Lowlands throughout California.	Sandy washes with open areas for sunning, bushes for cover, and loose soil for burrowing; near abundant food sources (ants and other insects).	Urban encroachment on habitat.	Not observed in Recon Study Area but may occur there. Nearest recorded observation was on Mt. Hamilton.
Western pond turtle Clemmys marmorata	SC/SSC	West of the Sierra-Cascade crest from sea level to elevations of approximately 6,000 feet.	Woodlands, grasslands, and open forests; occupies ponds, marshes, rivers, streams, and irrigation canals with muddy or rocky bottoms and vegetation to provide cover and food.	Loss and alteration of aquatic and wetland habitats; habitat fragmentation.	Observed in lower reaches of Guadalupe River and Coyote Creek. No known breeding habitat exists within Recon Study Area.
Fish					
Central Coast ESU steelhead trout Oncorhynchus mykiss	T/–	Central Coast Evolutionarily Significant Unit. Includes California streams from the Russian River to Aptos Creek, and the drainages of San Francisco and San Pablo bays east to and including the Napa River; does not include the Sacramento-San Joaquin River Basin.	Proposed critical habitat includes all river reaches and estuarine areas accessible to listed steelhead in California streams from the Russian River to Soquel Creek, California (inclusive), as well as the drainages of San Francisco and San Pablo bays.	Habitat loss and degradation resulting from urbanization of streams and riparian corridors.	Small remnant run of steelhead occurs in Coyote Creek and the Guadalupe River.
Central Valley ESU fall-run chinook salmon *Oncorhynchus tschawytcha*	C/–	Central Valley Evolutionarily Significant Unit. Includes all naturally spawned populations of fall-run chinook salmon in the Sacramento and San Joaquin River basins and their tributaries, east of Carquinez Strait. Encompasses part or all of the following California counties: Alameda, Butte, Calaveras, Colusa, Contra Costa, Glenn, Mariposa, Merced, Napa, Nevada, Placer, Plumas, Sacramento, San Joaquin, Santa Clara, Shasta, Solano, Stanislaus, Sutter, Tehama, Trinity, Tuolumne, Yolo, and Yuba.	Low-gradient coldwater streams.	Habitat loss and degradation resulting from urbanization of streams and riparian corridors.	A small run of chinook occurs in the Guadalupe River. This population is probably descendent from hatchery strays from the Sacramento River watershed.
Delta smelt *Hypomesus transpacificus*	T/T	Sacramento-San Joaquin River delta; seasonally in Suisun Bay, Carquinez Strait, and San Pablo Bay.	Most common in waters with salinity < 2 ppt; seldom found in salinities > 10 ppt.	Loss of habitat.	Not observed in the Recon Study Area, but may occur there.
Longfin smelt *Spirinchus thaleichthys*	SC/–	Ranges from Monterey Bay inland to Suisun Bay and north to Prince William Sound, Alaska.	Estuarine and open waters, including freshwater marshes. (Probably prefers fresh water.)	Reduced water quality; habitat degradation.	Not observed in the Recon Study Area, but may occur there.

Common Name ***Scientific Name***	**Status* Fed/State**	**California Distribution**	**Habitat**	**Reason for Decline/Concern**	**Potential for Occurrence in Recon Study Area**
Pacific lamprey *Lampetra tridentata*	SC/–	Upper drainages of the Sacramento-San Joaquin river system; below Friant Dam on the San Joaquin River; between Nimbus Dam and the Howe Avenue Bridge on the American River; below Red Bluff Dam on the Sacramento River; Napa River; below Boyes Spring Historical Park Dam on Sonoma Creek; above Concord Avenue bridge crossing in Walnut Creek.	Requires gravel substrate for spawning and mud substrate for rearing.	Habitat degradation.	Has been observed in the Guadalupe River and Coyote Creek. Recon Study Area offers suitable mud substrate for rearing habitat.
Sacramento splittail Pogonichthys macrolepidotus	T/–	Endemic to rivers and lakes of the Central Valley. Now confined to the Sacramento River Delta, Suisun Bay, and associated marshes.	Slow-moving river reaches and dead-end sloughs; requires flooded vegetation for spawning and rearing.	Habitat degradation; loss of marsh habitats; alteration of marsh habitats by dredging and filling.	Not observed in the Recon Study Area, but may occur there.
Tidewater goby *Eucyclogobius newberryi*	E/–	Along the coast, from the Smith River in northern California south to Agua Hediona Lagoon, San Diego County.	Brackish-water habitats; shallow lagoons and lower reaches of streams; requires still water with high dissolved oxygen content.	Habitat degradation and poor water quality.	Not observed in the Recon Study Area, but may occur there. Suitable habitat is present in San Francisco Bay and the area's sloughs and rivers.
Birds					
Alameda song sparrow *Melospiza melodia pusillula*	B/SSC	Southern San Francisco Bay area.	Forage and take cover in taller vegetation along tidal sloughs; breed in salt marshes.	Loss of habitat resulting from dredging, diking, and filling of marsh habitats.	May occur in the Recon Study Area; difficult to distinguish from other subspecies that occur in the area.
Bald eagle *Haliaeetus leucocephalus*	T(PD)/E	Year-round resident of mountain regions of northern California; winters throughout the state except for southern high-desert regions and parts of central inland California.	Uses ocean shorelines, lake margins, and rivercourses for nesting and foraging. Colonial nester; requires large or old-growth trees. Commonly nests in ponderosa pines.	Habitat loss as a result of urbanization.	Observed foraging in Recon Study Area in summer and fall.
Bank swallow Riparia riparia	B/T	Resident in riparian and coastal settings in northern and northeastern California; migrant throughout the state. Only remaining resident coastal colonies in the state are located at Fort Funston and Point Año Nuevo.	Coastals cliffs, inland bluffs and riverbanks; prefers riparian and other lowland habitats; usually found along aquatic habitat. Colonial nester; requires vertical banks with soft substrate for digging nest sites.	Habitat loss as a result of urbanization.	Rare visitor to the Recon Study Area in spring.

Common Name *Scientific Name*	Status* Fed/State	California Distribution	Habitat	Reason for Decline/Concern	Potential for Occurrence in Recon Study Area
Burrowing owl Athene cunicularia	SC/SSC	Lowlands throughout California, including the Central Valley, northeastern plateau, southeastern deserts, and coastal areas; rare along the south coast.	Uses rodent burrows in sparse grassland, desert, and agricultural habitats.	Loss of habitat; human disturbance at nesting burrows.	Several nesting colonies have been recorded in upland habitats of the Recon Study Area (Figure ____).
California brown pelican *Pelecanus occidentalis*	E/E	Along the coast from British Columbia to Central America. Breeding populations in Monterey County.	Coastal areas; on rocky shores and cliffs, in sloughs, and in coastal river deltas. Occasionally in inland lakes.	DDT contamination; overfishing of prey fish; human development around breeding and foraging habitat.	Non-breeding foragers observed in salt evaporation ponds A5–A7 and A9–A16; roosts on pond levees.
California clapper rail *Rallus longirostris obsoletus*	E/T	Salt and brackish marshes along San Francisco Bay.	Salt marshes with multiple tidal channels and vegetation dominated by cordgrass, pickleweed, and marsh gumplant.	Habitat loss and alteration as a result of filling, diking, and dredging.	Found along tidal sloughs and in tidal marshes in the Recon Study Area. Known to breed in the Recon Study Area.
California least tern *Sterna antillarum browni*	E/E	Nests in San Francisco Bay and in coastal areas from San Luis Obispo County south to San Diego County. Largest concentrations of breeding pairs nest in Los Angeles, Orange and San Diego counties. Sometimes seen around Salton Sea.	Sandy areas with sparse vegetation; mud flats; gravel substrates above high water.	Loss of habitat as a result of human encroachment; predation; dredging, filling, and pollution of estuarine habitats.	Observed foraging in the Recon Study Area; may also nest onsite.
Cooper's hawk Accipiter cooperii	–/SSC	Throughout California except at high elevations in the Sierra Nevada. Wintering populations use the Central Valley, the southeastern desert regions, and the plains east of the Cascade Range.	Nests primarily in riparian forests dominated by deciduous species; also nests in densely canopied forests from foothill pine-oak woodland up to ponderosa pine; forages in open woodlands.	Human disturbance at nest sites; loss of riparian habitats, especially in the Central Valley; pesticide contamination.	No recorded observations in the Recon Study Area. Marginally suitable habitat occurs in riparian areas; may be an occasional visitor.
Golden eagle Aquila chrysaetos	PR/SSC	Foothills and mountains throughout California; uncommon non-breeding visitor to the lowlands including the Central Valley.	Nests in cliffs and escarpments or in tall trees; forages in annual grasslands, chaparral, and oak woodlands with plentiful medium-sized and large mammals for prey.	Habitat loss as a result of urbanization.	No recorded observations in the Recon Study Area. Woodlands provide suitable foraging habitat; tall trees offer potentially suitable nesting habitat.
Loggerhead shrike *Lanius ludovicianus*	B/SSC	Grasslands throughout the state.	Forages in grassland or ruderal habitats.	Loss of grassland habitat as a result of urban expansion.	Nest sites have been documented in Recon Study Area.
Northern harrier *Circus cyaneus*	B/SSC	Marshes, fields, grasslands, and prairies throughout North America.	Coastal salt and freshwater marsh; nests on ground in shrubby vegetation, usually near marsh edge, or in grasslands; forages in grasslands.	Habitat loss as a result of urbanization and agricultural development; pesticide contamination.	Known to nest in Recon Study Area.

Common Name *Scientific Name*	**Status* Fed/State**	**California Distribution**	**Habitat**	**Reason for Decline/Concern**	**Potential for Occurrence in Recon Study Area**
Peregrine falcon *Falco peregrinus anatum*	delisted/E	In California, breeding range now includes the Klamath and Cascade ranges, the inland north-coastal mountains, the Sierra Nevada, and the Channel Islands.	Prefers sites near open areas but with nearby cliffs for nesting and roosting; found in wetlands, grasslands, and tundra, in open forest, and in mountains. Will occasionally nest on the ledges of tall buildings or bridges in cities.	Pesticide contamination; robbing of eyries by falconers; illegal shooting; human disturbance at nest sites.	Observed foraging in Recon Study Area; no suitable nesting habitat occurs in the area.
Salt marsh Common yellowthroat *Geothlypis trichas sinuosa*	B/SSC	Fresh and brackish marshes of the San Francisco Bay Area.	Freshwater and brackish marshes with emergent vegetation.	Loss of habitat resulting from dredging, diking, and filling of marsh habitats.	Known to nest along Guadalupe Creek and San Tomas Aquinas Creek.
Tricolored blackbird *Agelaius tricolor*	SC/–	From southern Oregon south through California's Central Valley and into Baja California.	Cattail and tule marshes; open valleys and foothills.	Loss of habitat resulting from dredging, diking, and filling of marsh habitats.	Occasional visitor to Recon Study Area.
Western least bittern Ixobrychus exilis hesperis	SC/–	Breeds in parts of the Central Valley and inland northern California. Resident populations occur on the southernmost coast and from the Salton Trough and lower Colorado River regions south into Baja California and mainland Mexico.	Freshwater and brackish marshes with dense, tall aquatic or semi-aquatic vegetation. Colonial nester; nests in low tules, over water.	Habitat loss as a result of urbanization.	Occasional visitor to the Recon Study Area in fall; rare visitor in winter.
Western snowy plover *Charadrius alexandrinus nivosus*	T/SSC	Beaches and coastal settings from southern Washington to southern Baja California, and some inland playa lakes, primarily in California.	Sandy coastal beaches and margins of inland playas; prefers flat, bare or sparsely vegetated substrates, particularly light-colored substrates.	Human disturbance; loss of habitat.	Known to nest in salt evaporation ponds A8D and A6 (Figure ____).
White-faced ibis *Plegadis chihi*	–/SSC	Year-round resident of Salton Trough; winters in parts of Central Valley, on the south coast, and from the lower Colorado River region south into coastal mainland Mexico.	Shallow freshwater marshes offering dense tule thickets for nesting and areas of shallow water for foraging.	Decline of suitable habitat.	Found in the Recon Study Area as a rare migrant and wintering species.
White-tailed kite *Elanus leucurus*	SC/SSC	Year-round resident in Oregon and California except at high elevations.	Low rolling foothills and valley margins with scattered oaks for nesting and perching; river bottomland and associated marsh habitat; open grassland.	Habitat loss as a result of urbanization.	Nests locally; known to occur in the Recon Study Area.
Mammals					

Common Name ***Scientific Name***	**Status* Fed/State**	**California Distribution**	**Habitat**	**Reason for Decline/Concern**	**Potential for Occurrence in Recon Study Area**
Salt marsh harvest mouse *Reithrodontomys raviventris*	E/–	Saline wetlands of San Francisco Bay. Southern subspecies (*R. r. raviventris*) occupies San Mateo, Alameda, and Santa Clara counties.	Salt marsh habitat that supports large stands of pickleweed.	Loss of habitat resulting from dredging and filling of pickleweed marshes around San Francisco Bay.	Found in New Chicago Marsh and Triangle Marsh (Figure ____). May occur elsewhere in the Recon Study Area in salt marsh dominated by pickleweed.
Salt marsh wandering shrew *Sorex vagrans halicoetes*	SC/–	Southern San Francisco Bay area.	Salt marshes 6–8 feet above sea level, where abundant driftwood is scattered among pickleweed.	Loss of habitat resulting from dredging, diking, and filling of marsh habitats.	Most recent survey (1970) recorded salt marsh wandering shrews in New Chicago Marsh.
Western mastiff bat *Eumops perotis*	SC/SSC	Eastern San Joaquin Valley from El Dorado County south through Kern County; Coast Ranges, Peninsular Range, and Transverse Ranges from San Francisco to the Mexican border.	Roosts and breeds in deep, narrow rock crevices; may also use crevices in trees, buildings, and tunnels. Forages in a variety of semiarid to arid habitats.	Unclear; possibly insecticide contamination and loss of foraging habitat; possibly disturbance of roosting sites.	No recorded observations in Recon Study Area. May occur in riparian woodland along Coyote Creek.
Townsend's Western big-eared bat *Plecotus townsendii townsendii*	SC/SSC	Coastal regions from Del Norte County south to Santa Barbara County.	Roosts in caves, tunnels, mines, and dark attics of abandoned buildings.	Unclear; possibly human disturbance of roosting sites.	No recorded observations in Recon Study Area; marginally suitable habitat is present in abandoned buildings in Drawbridge.
Pallid bat *Antrozous pallidus*	–/SSC	At low elevations throughout California.	Roosts in rocky outcrops, cliffs, and crevices; requires access to open habitats for foraging.	Human disturbance of roosting sites.	No recorded observations in Recon Study Area; marginally suitable habitat is present.

***Status Explanations:**

Federal Status:
E = listed as endangered under the federal Endangered Species Act
T = listed as threatened under the federal Endangered Species Act
PR = protected under the federal Golden Eagle Protection Act
C = federal candidate species (formerly Category 1; may be proposed for listing in the future)
– = no designation

State Status:
E = listed as endangered under the California Endangered Species Act
T = listed as threatened under the California Endangered Species Act
SSC = state species of special concern
– = no listing

Sources: California Department of Fish and Game website (http://www.dfg.ca.gov/endangered/index.html), U. S. Fish and Wildlife Service Division of Endangered Species website (http://www.endangered.fws.gov/r1spndx.html), Natural Diversity Data Base, Skinner and Pavlik (1994), Peterson (1990).

the WPCP's sludge ponds, sometimes in large numbers, and burrowing owls have been observed on the levees of the ponds. When the agricultural lands on the WPCP site are flooded, they provide foraging habitat for gulls, shorebirds, ducks and herons.

A.8.3.2 Wetlands

This section presents information on wildlife use of the wetland habitats shown in Figure A-6 as Salt Pond, Tidal Salt Marsh, Diked Salt Marsh, Brackish Marsh, Freshwater Marsh, Seasonal Wetland, and Enhanced and Constructed Wetland. The same habitat designations are used in the "Plant Communities" section above.

Marsh and wetland habitats of the Recon Study Area are home to a number of native and introduced mammal species. Native species that have been observed in the area or that are believed to be present in the Recon Study Area include: broad-footed mole (*Scapanus latimanus*), California myotis (*Myotis californicus*), Brazilian free-tailed bat (*Tadarida brasiliensis*), brush rabbit (*Sylvilagus bachmani*), desert cottontail (*Sylvilagus audubonii*), California jackrabbit (*Lepus californicus*), California ground squirrel (*Spermaophilus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), salt marsh harvest mouse (*Reithrodontomys raviventris*), western harvest mouse (*Reithrodontomys megalotis*), deer mouse (*Peromyscus maniculatus*), California vole (*Microtus californicus*), raccoon (*Procyon lotor*), and striped skunk (*Mephitis mephitis*). Desert cottontails use the levee roads and the ruderal vegetation associated with the area's levees. Muskrats have been observed swimming in the sloughs and entering burrows in the levees (Padley 2000). The salt marsh wandering shrew and salt marsh harvest mouse may breed in nontidal and muted tidal salt marsh habitat at the WPCP. Introduced mammals that have been observed or that are suspected to occur in the Recon Study Area include: Virginia opossum (*Didelphis virginiana*), black rat (*Rattus rattus*), Norway rat (*Rattus norvegicus*), house mouse (*Mus musculus*), and red fox (*Vulpes vulpes*) (RRM Design Group and Habitat Restoration Group 1999). Feral cats and dogs are likely common in the Recon Study Area. Introduced species have been observed preying on nesting birds and their eggs (Ryan 1998).

Various birds, including several types of neotropical passerine birds, use the area's riparian marshes during the spring and fall. Perennial and seasonal wetlands at the WPCP provide potential breeding and/or foraging habitat for the Alameda song sparrow, salt marsh common yellowthroat, burrowing owl, American coot, and black-necked stilt, and for various egrets, herons, and geese. The Alameda song sparrow, and the salt marsh common yellowthroat may breed in nontidal and muted tidal salt marsh habitat at the WPCP.

Tidal Wetlands

The following section discusses wildlife use of tidally influenced wetlands in the Recon Study Area, including habitats shown on Figure A-6 as Tidal Salt Marsh, Brackish Marsh and Freshwater Marsh along the lower Guadalupe River (Alviso Slough) and Coyote Creek (Coyote Slough and Mud Slough). Use of tidally influenced wetland habitats by some groups, such as birds and mammals, is similar in saltwater, brackish and freshwater habitats. Use by other groups, such as invertebrates, is believed to differ substantially from salt- to freshwater habitats, but specific data are lacking. For simplicity, wildlife use is described for tidal wetlands as a whole, except where otherwise noted.

Invertebrates

Very little is known about invertebrate use of the wetlands in the Recon Study Area. However, previous workers have documented at least two species of mollusks in Alviso Slough. *Macoma baltica (M. inconspicua)* is the most abundant mollusk found at the mouth of Alviso Slough (Trapani 1981). The eastern mud snail (*Nassarius obsoletus*) also occurs there.

Birds

The San Francisco Bay Bird Observatory (SFBBO) has carried out extensive surveys along Alviso Slough, in the open water of the slough channel and in adjacent tidal marshes. The predominant bird species recorded by SFBBO during their summer surveys are, in order of decreasing numerical importance, ring-billed and California gulls, avocets and stilts, least and Western sandpipers, barn and cliff swallows, and dowitchers (Table A-9). The predominant species recorded in fall surveys are least and Western sandpipers, ring-billed gulls, dowitchers, and American coots. Foraging ducks, shorebirds, herons and egrets are also found in Alviso Slough, particularly during the nonbreeding season (Table A-9). In addition, song sparrows, marsh wrens, some kinds of ducks (primarily mallard and gadwall), and Canada geese nest along the slough's periphery. No systematic bird survey data are available for any of the other locations/habitats in the Recon Study Area. The California clapper rail has been recorded in or near areas dominated by alkali bulrush and is expected to be present in the salt marshes closer to Coyote Creek.

General patterns of bird use in Guadalupe Slough and Coyote Creek/Coyote Slough are similar to those in Alviso Slough. The salt marsh habitat along the edges of Guadalupe Slough is so narrow that only the lower, somewhat wider section adjacent to salt pond A5 is suitable for the California clapper rail (see "Special-Status Fish and Wildlife Species" below). Large numbers of gulls, herons, terns and ducks forage along Coyote Creek/Coyote Slough. Many shorebirds also forage along the marshes and mudflats at low tide.

In general, bird use in Artesian Slough is also similar to that in Alviso Slough. Most of the habitat along Artesian Slough is freshwater marsh; some brackish marsh habitat is present near the confluence with Coyote Creek. Large numbers of gulls and waterfowl congregate along Artesian Slough. The heron and egret breeding colony along the central portion of Artesian Slough is one of the largest and most diverse in California. Five species of herons and egrets nest in this area, including snowy egrets, great egrets, black-crowned night herons, little blue herons and cattle egrets. By contrast, very few shorebirds are found in Artesian Slough, although American avocet and black-necked stilt forage on its mudflats at low tides.

A.8.3.3 Non-Tidal Wetlands

This section presents information on non-tidal wetland habitats of the Recon Study Area. These habitats are shown on Figure A-6 as Diked Salt Marsh and Salt Ponds Seasonal Wetland. The same designations are used in the "Plant Communities" section above.

Diked Salt Marsh

Birds

Shorebirds and waterfowl use diked salt marshes. Birds that have been observed roosting or foraging throughout New Chicago Marsh include killdeer, mallards, Northern Shovelers, Canada geese, snowy egrets, great egrets, California gulls, and ring-billed gulls. American avocet and black-necked stilt nested in upland areas of the site and produced several young in 1994 (H.T. Harvey & Associates 1995). Birds commonly observed foraging in the wet portion of the marsh include greater yellowlegs, dowitchers, least sandpipers, and black-necked stilt. Some less common species include ruff, lesser yellowlegs, pectoral sandpiper, and stilt sandpiper. Avian predators, such as Northern harrier and golden eagle, often hunt for small mammals in diked salt marsh areas.

Mammals

Little is known about mammal usage of the Recon Study Area's diked salt marshes. However, repeated studies over a number of years have documented the presence of salt marsh harvest mice in New Chicago Marsh (see "Special-Status Fish and Wildlife Species"). This area is considered a key component in the preservation and recovery of the species. The salt marsh vagrant shrew is also likely present in Alviso's diked salt marshes.

Salt Ponds

Invertebrates

Lonzarich (1989) found 17 genera of invertebrates in ponds A9–A15. He did not study pond A16 but the physical conditions in this pond are most similar to those in pond A15. Fifteen genera were represented in pond A9, 14 in pond A10, six in ponds A11–A13, and two in A15. Thus, invertebrate species diversity was much higher in ponds A9–A10 than in ponds A11–A15. Unless otherwise cited, all data regarding the Alviso ponds (A9–A15) are from Lonzarich (1989).

Cnidaria

Sea anemones (*Actiniaria* spp.) were found in pond A9.

Nematodes and Nemerteans

Nematodes (species identification not available) and nemerteans are abundant bottom-dwellers among organic matter and in the black mud of the low-salinity Knapp ponds (Carpelan 1957). No nematodes have been reported in the Alviso ponds.

Annelids

Annelids reported in the Recon Study Area included polychaetes and oligochaetes. The most prevalent annelid found in the Knapp salt ponds by Carpelan (1957) was a polychaete, *Polydora ligni*, which lives on the bottom of the ponds among dead algae. These worms were found in salinities ranging from 23 ppt to 40 ppt. Ponds A9 and A10 contain *P. lingi*, as well as the polychaete *Nereis succinea* and the oligochaete *Tubificoides* sp.

No annelids have been found in ponds A11–A15. However, Trapani (1981) recorded high densities of the oligochaetes *Peloscolex* spp. and a polychaete *Eteone lighti* at the mouth of Alviso Slough.

Crustaceans

Lonzarich (1989) documented ten genera of crustaceans from the Alviso ponds. He recorded representatives of eight genera from ponds A9 and A10, four from ponds A11–13, and two from pond A15 (Lonzarich 1989). By contrast, brine shrimp (*Artemia salina*) and copepods were the only crustaceans reported by Carpelan (1957).

Branchipods

Brine shrimp are the most abundant invertebrate recorded in the Recon Study Area's salt pond complex. Brine shrimp are present in ponds A10–A15; they are sparse in pond A10, more abundant in ponds A11–A15, and most abundant in pond A15. Although ponds A9 and A10 have a greater overall species diversity, zooplankton biomass is substantially higher in pond A15, primarily because of the abundance of brine shrimp, which make up 71% of pond A15's biomass.

The optimal salinity range for brine shrimp is 2–5 times that of seawater, or 70–175 ppt. In the Knapp ponds, populations of brine shrimp yield 13 g/m^3. Assuming eight generations per year, with the greatest productivity during summer and early fall, Carpelan (1957) estimated that annual brine shrimp production in the most saline ponds of the Recon Study Area is 56 lbs/acre.

Copepods

Copepods are the second most abundant invertebrate recorded in the Knapp and Alviso pond complex. During repeated sampling conducted at the mouth of Alviso Slough during June–August 1980, zooplankton was extremely abundant (mean abundance = 55 animals/m^3) relative to adjacent waters in southern San Francisco Bay and Coyote Creek. Three species of calanoid copepods, *Acartia clausi, A. californiensis*, and *Eurytemora affinis*, made up 98.1% of the zooplankton sampled in Alviso Slough (Williamson 1981).

According to Carpelan (1957), the copepod *Pseudodiaptomus euryhalinus* predominates in both the Knapp and Alviso ponds during summer. Copepod populations decrease in June and July, concurrent with the development of large populations of juvenile topsmelt (*Atherinops affinis*; see below). When topsmelt populations decrease again in August and September, copepod populations increase correspondingly (Carpelan 1957).

Copepods typically occur in low to moderate salinities of 25–60 ppt. Although copepods have been found in all of the Knapp and Alviso ponds, in general they are most abundant in lower-salinity ponds, and are replaced by brine shrimp in ponds of higher salinity.

Decapods

A variety of decapods have been reported from the Recon Study Area. *Crangon* spp., *Palaemon macrodactylus*, and *Hemigrapsis oregonensis* have been found in Alviso ponds A9 and A10, although they are not known from ponds A11–A15. Carpelan (1957) found one species of decapod, *Limnoria lignorum*, in the Knapp ponds. It is not abundant, and is apparently restricted to the shoreline bordering the brackish waters of the tidal pond nearest to the pond's Bay inlet.

Amphipods

Amphipods are also present in the salt pond complex. One species, *Corophium spinicorne*, has been found in the Knapp ponds; it is supported in large numbers when the green algae is dense (Carpelan 1957). *Corophium spinicorne* and *Anisogammarus confervicolus* were also found in the Alviso ponds. The former was found in ponds A9–A11, and the latter was found only in ponds A9 and A10.

Insects

Water boatmen (*Trichocorxia reticulata*) have been found in all of the salt ponds except pond A15. In the Knapp ponds they are the most abundant invertebrate in ponds of intermediate salinity. In the Alviso ponds, they occur in the low-salinity ponds (A9 and A10), but are most abundant in the ponds with moderate to high salinities. Adults are found in the ponds throughout the year and young are present from spring to fall.

Various flies have also been documented in the salt pond complex. The salt marsh fly (*Ephydra millbrae*) can be found in all of the salt ponds, but is most abundant in high-salinity ponds. The drone fly (*Eristalis tenax*) and kelp fly (*Fucellia rufitibia*) are also present, though less abundant, at low-salinity ponds.

Mollusks

Both pelecypods and gastropods are present in the Recon Study Area. The gem clam (*Gema gema*), eastern mud snail, and mimic *Tryonia* or California brackish water snail (*Tryonia imitator)* occur in ponds A9 and A10. No mollusks were found in ponds A5–A8 (Carpelan 1957).

Fishes

Lonzarich (1989) recorded 15 species of fishes in the Alviso salt ponds, including 15 species in pond A9, 13 species in pond A10, and six in each of the other ponds (A11–A15). The predominant fish species are topsmelt (*Atherinops affinis*), which are most numerous, and longjawed mudsucker (*Gillichthys mirabilis*); both topsmelt and longjawed mudsucker have resident, spawning populations in all six ponds (A9–A15) (Lonzarich 1989; see also Carpelan 1957).

Topsmelt prefer salinities of 30–75 ppt, but can survive in salinities as high as 90 ppt (Carpelan 1957, Lonzarich 1989). The spawning season for topsmelt is from February to September, with a peak between March and July. The diet of topsmelt varies with salinity. In high-salinity ponds they eat primarily brine shrimp, water boatmen, and copepods. In low-salinity ponds (A9 and A10), *C. spinicorne* are their primary prey during *Enteromorpha* blooms; they feed primarily on planktonic algae (diatoms) and copepods during phytoplankton blooms.

Longjawed mudsuckers are most abundant in the Recon Study Area in summer and fall; they are much less so in winter and spring (Lonzarich 1989). They are typically most abundant in the salt ponds with the highest salinities. They spawn from November through June. They feed primarily on polychaetes and *C. spinicorne* in the low-salinity ponds, and on brine shrimp and water boatmen in high-salinity ponds.

In addition to topsmelt and longjawed mudsucker, Lonzarich (1989) documented six other resident fish in the salt ponds: yellowfin goby (*Acanthaogobius flavimanus*), threespine stickleback (*Gasterosteus aculeatus*), rainwater killifish (*Lucania parva*), and Pacific staghorn sculpin (*Leptocottus armatus*). Yellowfin gobies were most abundant in ponds A9 and A10. Although gravid goby females were recorded, their numbers were low except when the ponds were receiving water from the Bay, suggesting that they may have immigrated into the salt ponds from the Bay. Gobies eat primarily polychaete and oligochaete worms in low-salinity ponds, and brine shrimp and juvenile yellowfin gobies in high-salinity ponds. Killifish and sticklebacks are most abundant in the low-salinity ponds (A9 and A10). They probably make seasonal use of the high-salinity ponds as well. Both killifish and sticklebacks feed exclusively on crustaceans, including amphipods inhabiting *Enteromorpha* in the low-salinity ponds, and brine shrimp and copepods in the more saline ponds. In late spring, staghorn sculpins were the most abundant species of fish collected in ponds A9 and A10. Adult sculpin feed on killifish, gobies, and decapods (*Crangon* spp.). Juvenile sculpin feed on polychaetes and amphipods in low-salinity ponds, and on brine shrimp in high-salinity ponds.

Nine species of nonresidents use pond A9, including the bay ray (*Myliobatis californica*), leopard shark (*Triakis semifasciata*), northern anchovy (*Engralis mordax*), bay pipefish (*Syngnathus leptorhynchus*), bay goby (*Lepidogobius lepidus*), shiner perch (*Cymatogaster aggregata*), starry flounder (*Platichthys stellatus*), English sole (*Parophrys vetulus*), and striped bass (*Roccus saxatilis*). All of these species except the English sole and striped bass were also recorded in pond A10.

Birds

To date, no systematic surveys have been conducted on the salt ponds of the Recon Study Area for birds, other than for listed species. Most of the salt ponds are used by a variety of ducks, shorebirds, egrets, gulls, and terns for foraging, roosting, and, in some cases, nesting. However, certain ponds are known to be particularly important to some species for breeding and roosting. These ponds are discussed below.

Pond A5

Many birds of different kinds use habitat provided by pond A5, because this pond offers a wide variety of habitats, including deepwater areas and, especially during summer and fall when water levels are lower, extensive areas of shallow water and mud. Waterfowl, shorebirds, gulls, terns, ardeids, and pelicans forage and roost at pond A5. Forster's terns nest on islands and on duck blinds in the pond; islands in pond A5 support what is probably the only Caspian tern colony in Santa Clara County. Pond A5 is also home to many nesting avocets and stilts, and some nesting ducks, as well as large concentrations of Wilson's and red-necked phalaropes in the fall. Snowy plovers have been recorded at pond A5 since the 1970s, and may nest there (see "Special-Status Fish and Wildlife Species").

Pond A6 (FWS)

The area around pond A6 has the largest California gull colony in the San Francisco Bay area. Pond A6 is usually dry, but channels around the pond's periphery provide foraging habitat for shorebirds, gulls, terns, and ducks. Birds that nest at pond A6 include avocets and stilts.

Pond A9

Pond A9 supports the greatest number and diversity of waterbirds of any pond in the Recon Study Area. Large numbers of diving and dabbling ducks use pond A9 from winter through spring. During late summer and fall, when reduced water levels expose the greatest area of mud, the pond's mudflats are used by thousands of roosting and foraging shorebirds, and by significant numbers of pelicans and cormorants. Some American avocets and black-necked stilts nest on the levees around the pond. In addition, pond 9 is one of the primary feeding areas for herons nesting at the Artesian Slough heronry, especially during the heron nesting period.

Pond A10

Pond A10 supports a variety of uses. Many waterfowl forage at pond A10, particularly diving ducks such as greater and lesser scaups, canvasbacks, and ruddy ducks. Pond A10 also provides foraging, roosting, and bathing habitat for moderate numbers of gulls. In addition, during the past few years the levee between ponds A9 and A10 has served as an "overflow" nesting area for California gulls from the colony in pond A6 across Alviso Slough. In 1998, double-crested cormorants, the only ground-nesting cormorants in the South Bay, nested on the levees as well. These levees, and pond A10, are often used by large numbers of roosting and foraging white and brown pelicans.

Pond A16

Because of pond A16's high salinity, it supports a low diversity of bird species. However, islands within the pond support large numbers of nesting Forster's terns, American avocets, and black-necked stilts. Black skimmers have been recorded as summer visitors in pond A16's tern colonies and may nest there.

As discussed above, the largest heronry in Santa Clara County is located along Artesian Slough, which borders the northeast side of pond A16. It supports large numbers of great and snowy egrets as well as black-crowned night herons. A few little blue herons and cattle egrets are usually present, and, rarely, white-faced ibises nest here as well.

A.8.3.4 Open Water

Amphibians

Very little is known about amphibian populations in the Recon Study Area. Because amphibian habitat in the Recon Study Area is typically disturbed or saline, species diversity is low. The Pacific tree frog (*Pseudacris regilla*) and the Western toad (*Bufo boreas*) may breed in freshwater ponds (seasonal wetlands) in the Recon Study Area.

Fishes

Very little is known about fish populations in open waters of the Recon Study Area. However, in saline open water near the mouth of Coyote Creek, surveys collected individuals representing 15 species; 97% belonged to five species: Pacific staghorn sculpin, starry flounder, northern anchovy, yellowfin goby, and shiner perch (RRM Design Group and Habitat Restoration Group 1999). In addition, both steelhead trout (*Oncorhynchus mykiss*) and chinook salmon (*Oncorhynchus tshawytscha*) are known to use Alviso Slough and the Guadalupe River when they migrate to their spawning grounds upstream of the Recon Study Area.

Mammals

Data on mammal use of the Recon Study Area's open water habitats are sparse. However, pinnipeds are known to be regular visitors to the Recon Study Area's sloughs. Harbor seals (*Phoca vitulina*) make frequent use of Coyote Creek and Coyote Slough, hauling out on the north side of Coyote Creek across from the mouth of Alviso Slough. In Alviso Slough, harbor seals have occasionally been observed as far upstream as Alviso Marina (Duke pers. comm.).

Riparian Woodland and Forest

The Recon Study Area contains limited areas of riparian woodland and forest (Figure A-6). Nonetheless, riparian woodland along Coyote Creek is an important habitat for many neotropical migrant birds, including Western tanagers, Northern orioles, and several species of warblers. Raptors such as the red-shouldered hawk nest in the Coyote Creek riparian corridor, and a variety of other species also use this habitat for nesting and foraging.

A.8.4 SPECIAL-STATUS FISH AND WILDLIFE SPECIES

The following paragraphs provide descriptions of special-status species that are known to breed or forage within the Recon Study Area. Table A-10 summarizes information on all special-status wildlife species that occur or may occur in the Recon Study Area. Note that the Recon Study Area provides no suitable habitat for special-status amphibians, including the California tiger salamander (*Ambystoma californiense*) and California red-legged frog (*Rana aurora draytonii*).

A.8.4.1 Central California Coast ESU Steelhead Trout (Oncorhynchus mykiss)

Steelhead trout of the Central California Evolutionarily Significant Unit (ESU) are federally listed as threatened. Steelhead trout are known to move through the Recon Area during their upstream migration into the Guadalupe River and Coyote Creek. The Recon Study Area is also used by maturing steelhead smolts as they undergo the physiological changes that permit them to survive in the salinity of the ocean. Steelhead move into the streams of the Recon Study Area during winter high flow, from late October through January. Steelhead spawning peaks between January and March. Adult steelhead construct spawning redds in relatively clean, loose gravels, typically at the downstream ends of pools and at the heads of riffles with appropriate depths and velocities. Unlike Pacific salmon, which die after spawning, steelhead are capable of returning to the ocean after spawning, typically by June of the spawning year.

A.8.4.2 Chinook Salmon (Oncorhynchus tschawytcha)

Chinook salmon are a federal candidate species. Adult fall-run chinook migrate upstream into rivers from July through December; the timing of the runs varies from year to year depending on variations in riverflow. Spawning takes place from early October through late December, peaking in October and November. Eggs incubate from October through March. Juveniles rear and smolts emigrate from January through June. The majority of young fall-run chinook salmon migrate to the ocean during the first few months following emergence (RRM Design Group and Habitat Restoration Group 1999).

Chinook salmon are known to occur in the Guadalupe River and in Guadalupe Creek, but the affinity of South Bay chinook populations is contested. According to NMFS ESU descriptions, populations of chinook salmon in Guadalupe Creek are located outside both the California Coastal ESU and the Central Valley ESU. However, based on their life history, NMFS biologist Mark Helvey has determined that Guadalupe Creek chinook belong to the Central Valley fall-run ESU chinook population. The South Bay population may be an unrecorded remnant population native to the Guadalupe River, or they may be "stray" wild and/or hatchery fish that were drawn to Guadalupe Creek by their attraction to the imported water from the Sacramento River.

A.8.4.3 California Clapper Rail (Rallus longirostris obsoletus)

The California clapper rail is federally listed as endangered and state-listed as threatened. It breeds primarily in salt marshes along the edge of San Francisco Bay. It is most abundant in extensive salt marshes dominated by cordgrass, pickleweed, and marsh gumplant and associated with secondary tidal channels (Harvey 1980). Within these salt marshes, nests are placed in or under marsh vegetation, including cordgrass, pickleweed, and marsh gumplant, as well as saltgrass and tidal wrack (DeGroot 1927, Evens and Page 1983, Harvey 1980, Foerster et al. 1990). The clapper rail breeding season runs from mid-March through July, peaking in May and June. The California clapper rail typically forages on exposed mud along tidal channels or in vegetation at the edges of such channels; secondary channels are apparently preferred (Shuford 1993). In winter, California clapper rails forage primarily in cordgrass-dominated habitat in the lower Guadalupe marsh (Kelly pers. comm., cited in Shuford 1993), although tall vegetation at the edges of the upper marsh provides important cover during high winter tides.

California clapper rails also breed in brackish marshes, especially those dominated by alkali bulrush; however, the importance of these marshes to the California clapper rail is not well understood (H. T. Harvey & Associates 1989, 1990b, 1991a, 1991b, Collins et al. 1994). Breeding-season surveys of marshes in southern San Francisco Bay by Gill (1979) found California clapper rails in salt marshes west of Drawbridge (Figure A-6) but found none in more brackish marshes to the east, although California clapper rails had been recorded in those marshes during the winter. Similarly, intensive surveys during the 1989 breeding season detected no California clapper rails in brackish marshes east of Drawbridge, and found that California clapper rails west of Drawbridge were more strongly associated with cordgrass-dominated habitats than with alkali bulrush (H.T. Harvey & Associates 1989). By contrast, the 1989 surveys documented breeding California clapper rails in a wide variety of plant associations. Surveys of the same areas in winter 1989–1990 and during the breeding season of 1990 found a number of California clapper rails occupying brackish, alkali bulrush-dominated marshes well east of Drawbridge (H.T. Harvey & Associates 1990a, 1990b). Moreover, California clapper rails were found in nearly pure stands of alkali bulrush along Guadalupe Slough in 1990 and 1991 (H.T. Harvey & Associates 1991a, 1991b). Although it has been suggested that habitat quality may be lower in brackish marshes than in salt marshes (Shuford 1993), further studies comparing reproductive success in different marsh types will be necessary to determine the value of brackish marshes to California clapper rails.

Habitat along much of Alviso Slough and Guadalupe Sloughs is of moderate to low quality for breeding California clapper rails. Diking of wetlands for the creation of salt evaporation ponds adjacent to Alviso Slough reduced the banks of the slough to narrow linear strips. As a result, stands of cordgrass and bulrush are too narrow in many places to provide suitable nesting habitat. Also, the main sloughs offer few of the secondary channels preferred by foraging rails. Surveys at other locations in the South Bay with plant associations similar to those along Alviso Slough have found California clapper rails to be more numerous in broad expanses of marsh with numerous secondary channels than in narrow strips of marsh such as those found along Alviso Slough (H.T. Harvey & Associates 1989, 1990b). Habitat quality is further limited in the slough's uppermost reaches (from the Gold Street Bridge downstream to, and including, Alviso Marina) because this portion of the slough is essentially a freshwater environment. Nevertheless, some of the broader expanses of tidal marsh with secondary channels along the middle and lower reaches of Alviso Slough, including some areas dominated by alkali bulrush, provide potentially suitable nesting and foraging habitat for at least a few pairs of California clapper rails.

Few surveys for California clapper rails have been conducted in the Recon Study Area. Most surveys for this species in the southern San Francisco Bay area have focused on more extensive marshes (e.g., Harvey 1980, Moss 1980, Foerster et al. 1990). Nevertheless, several surveys documented California clapper rails along the southern margin of Coyote Creek (the northern border of the Recon Study Area) and along Alviso Slough and Guadalupe Slough.

A number of breeding-season surveys have documented the presence of the California clapper rail in the Recon Study Area. In the early 1970s, Gill (1979) recorded California clapper rails "along the larger fringing marshes of Guadalupe and Alviso sloughs." During 1989, breeding-season surveys of a 26-acre section of transitional salt/brackish marsh approximately 3.5 km upstream from the mouth of Alviso Slough recorded five California clapper rails. These included one pair using a narrow strip of cordgrass along the main slough, another pair using a mixture of cordgrass and alkali bulrush, and a single individual in a pure stand of alkali bulrush (H.T. Harvey & Associates 1989). Two pairs were found occupying the same marsh in spring 1990 (H.T. Harvey & Associates 1990b). Breeding-season surveys in 1990 recorded a pair along Guadalupe Slough adjacent to the southern boundary of Pond A5 (H.T. Harvey & Associates 1991a), as well as several pairs in the salt marsh habitat along the southern margin of Coyote Slough (H.T. Harvey & Associates 1990b). Particularly favorable locations in this tract were at Triangle Marsh and Goose Point.

Winter surveys by Harvey (1980) found no California clapper rails in the bulrush-dominated habitat along upper Alviso Slough but detected two individuals in mixed cordgrass/pickleweed salt marsh approximately 2.5 km downstream from Alviso Marina. SFBBO's annual winter surveys for California clapper rail do not typically cover most of Alviso Slough, although these surveys did detect one individual approximately 2.8 km downstream from Alviso Marina on 10 December 1993 and three individuals at the mouth of the slough on 1 January 1995 (J. Albertson in litt.).

Incidental observations also attest to the presence of the California clapper rail in the Recon Study area. Individuals have occasionally been recorded along the upper reaches of Alviso Slough between the Gold Street Bridge and Alviso Marina; both plant communities and salinities in this area are typical of freshwater rather than brackish systems. In the late 1980s, a single male was seen and heard calling near Alviso Marina by H.T. Harvey & Associates biologists, although repeated surveys failed to detect any California clapper rails in the area on subsequent dates. Another calling individual was heard near Alviso Marina by an H.T. Harvey & Associates biologist on 2 May 1997, although repeated surveys again failed to relocate the bird on subsequent dates. In June 1997, an H.T. Harvey & Associates biologist heard two individuals calling and saw one individual in the vegetation along the south side Alviso Slough adjacent to the marina. Between 1989 and 1998, SFBBO's annual summer and fall botulism surveys along Alviso Slough in the vicinity of the marina produced only one clapper rail record (1 October 1997) during a total of 166 surveys (SFBBO unpublished reports). In spring 1997, a single individual was heard by an H.T. Harvey & Associates ornithologist just below the Gold Street Bridge. This represents the uppermost record along the slough.

One record for California clapper rail is known from the Highway 237 Mitigation Site.

A.8.4.4 Western Snowy Plover (Charadrius alexandrinus nivosus)

The Western snowy plover is federally listed as threatened and is a state species of concern. The Western snowy plover historically nested primarily on sandy coastal beaches and on the margins of alkali lakes and playas in inland areas. It is not known whether this species nested inside San Francisco Bay before the conversion of salt marsh to salt evaporation ponds. However, the evaporation ponds have provided suitable nesting and foraging habitat since the beginning of the 20th century (Grinnell et al. 1918), and currently about 10% of the California population of snowy plovers breeds in San Francisco Bay salt ponds, mostly in the South Bay region (Page and Stenzel 1981, Page et al. 1991).

In the South Bay, the snowy plover nests on flat, bare or sparsely vegetated substrates, particularly on light-colored substrates such as salt flats (Feeney and Maffei 1991). Nests may be placed on dry salt flats, on salt pond levees, or on islands in the ponds (Cogswell 1977). Nesting adults and their chicks forage almost entirely within the salt ponds or on surrounding levees.

Snowy plovers were recorded nesting on salt pond levees in Alviso as early as 1947 (*Bulletin of the Santa Clara Valley Audubon Society*, August 1947, pp. 1–2). By this time, the snowy plover was likely well established as a breeder in the Alviso area. Breeding was confirmed here nearly every year during the 1950s (*Audubon Field Notes* 5:273, 10:359, 11:374, 13:451, Sibley 1952), with a high of 14 nests found in 1955 (*Avocet* 2(5):25–26). In 1971, snowy plovers nested at the northern end of ponds A5 and A6 near the mouth of Alviso Slough, on the Knapp Gun Club property (Gill 1972). Page and Stenzel (1979) recorded snowy plovers in each of the three salt evaporation ponds bordering the south side of Alviso Slough (ponds A6, A7, and A8; see Figure A-6). They found a nest in pond A6, a brood on a levee bordering pond A7, and a single individual in pond A8.

The most recent information on snowy plover distribution along Alviso Slough has been compiled from incidental observations made by SFBBO during surveys of colonial waterbirds that use the salt evaporation ponds along the slough (Ryan and Parkin 1998). These surveys recorded and confirmed snowy plovers nesting in two of the three salt evaporation ponds bordering the southern side of Alviso Slough (ponds A6 and A8; see Figure A-6). In pond A6, at the lower end of Alviso Slough, SFBBO detected snowy plovers during every year in which surveys were conducted between 1986 and 1994. As many as 18 adult individuals were recorded in a single survey; the average observation was 4.0 adults/survey. Breeding was confirmed in pond A6 in five of the nine survey years, with a peak count of two nests on 14 May 1994. SFBBO has not recorded snowy plovers in pond A7. However, numerous sightings and confirmed nesting have been documented in pond A8, located south and west of the uppermost reaches of Alviso Slough (Figure A-6). Snow plovers were recorded in pond A8 in 11 of the 13 years between 1981 and 1997 in which SFBBO conducted surveys. As many as 20 adult individuals were recorded in a single survey; the average observation was 9.4 adults/survey. Breeding was confirmed during nine years, with a high of 19 active nests on 3 July 1996. The vast majority of snowy plover activity in pond A8 took place at the southern end of the pond, which is mostly dry during the breeding season in most years. Because SFBBO's survey data were collected only from levees, occasionally without the use of a spotting scope, and without standardized survey protocols, SFBBO survey data represent a minimum estimate of the actual number of plovers using these ponds.

Incidental observations on pond A8 made by birders (most viewing from the observation platform south of San Tomas Aquinas Creek) and by other observers complement SFBBO's data. On 4 June 1989, a year in which SFBBO did not conduct breeding-season surveys at these ponds, a brood of snowy plover chicks was seen at the west end of pond A8 (Mammoser pers. comm.). On 4 June 1993, another year in which SFBBO conducted no surveys, at least nine snowy plovers were seen in the south-central portion of pond A8 by H.T. Harvey & Associates biologist Dr. Steve Rottenborn. Although breeding was not confirmed in 1997, birders observed 1–2 adult snowy plovers in pond A8 on four dates between 8 April and 13 August of that year. On 13 May 1998, 19 adults and three active nests were observed at the south end of pond A8, and in 1999, protocol-level snowy plover surveys detected as many as 10 adults and one nest (H.T. Harvey & Associates 1999b).

Snowy plovers have occasionally been recorded foraging in the diked ponds northeast of Alviso Slough (ponds A9–A12) by birders. However, ponds A10, A11, and A12 usually contain water year-round, and water in pond A9 generally does not begin to recede until late summer. As a result, snowy plovers probably do not nest in or around these ponds, or do so only sporadically and in small numbers. Past surveys of snowy plovers in the southern San Francisco Bay area (Gill 1972, Page and Stenzel 1979) failed to find nesting plovers in these ponds. The only recent nesting records in the vicinity of these ponds consist of 1 to 2 pairs that nested in some years in a small impoundment between pond A12 and the railroad tracks, north of the Alviso Marina and well removed from Alviso Slough (Rogers and Mammoser pers. comm.).

One record for nonbreeding snowy plover is known from the Highway 237 Mitigation Site.

A.8.4.5 California Least Tern (Sterna antillarum browni)

The California least tern is both state- and federally listed as endangered. California least terns are colonial nesters that breed in the San Francisco Bay Area. Breeding occurs from late April though July. Nest sites are typically located in open areas above the high water mark and safe from predation. Terns create a shallow scrape nest and prefer an unvegetated sandy substrate; they also use sandy areas with sparse vegetation, mud flats, and gravel substrates. The primary factors in the decline of California least tern populations have been: habitat loss resulting from shoreline development; predation by feral and wild animals; and dredging, filling, and water pollution in estuarine and offshore foraging areas.

Neither H.T. Harvey & Associates nor Jones & Stokes has conducted surveys for California least tern in the Recon Study Area. The main postbreeding (fall) staging areas for the least tern in the South Bay are the complex of ponds immediately north of Moffett Field and, to a lesser extent, the vicinity of Shoreline Park in Mountain View. Least terns may forage more regularly in ponds A5 and A7 than in other ponds in the study area.

A.8.4.6 California Black Rail (Laterallus jamaicensis coturniculus)

The California black rail is state-listed as threatened. Black rail habitat is the salt marsh vegetation that occurs on the gently sloping plain between the high-tide line and the upland shore. This high-tide marsh may represent the single habitat in the San Francisco Bay Area that has been most altered since the California Gold Rush and resulting changes in land use. A study in the 1970s determined that the upper salt marsh habitat now averages only about three meters in width. Along the tide-line, construction of levees, dikes, salt ponds, roads, factories, landfills, recreation paths, parking lots and sewage treatment plants has eliminated the refugia and habitats of a range of species dependent on the high-water habitat associated with the black rail.

The California black rail is primarily found in tidal marshes of the northern San Francisco Bay region. However, scattered populations have been observed in South Bay marshes. Amateur birders have reported black rails clinging to emergent vegetation during flood events. They have also often reported that rails are preyed upon in this state by hawks, herons or egrets (*Tideline* Vol. 19, No. 4).

A.8.4.7 Burrowing Owl (Athene cunicularia)

The burrowing owl is a state species of concern. The burrowing owl is a small, terrestrial owl that inhabits flat open grasslands, ruderal fields, large urban lots, or other sparsely vegetated ecosystems. They prefer annual or perennial grasslands, typically with sparse or nonexistent tree or shrub canopies. The nesting season is from February through August. Burrowing owls are often colonial nesters; in the San Francisco Bay area they generally use abandoned ground squirrel burrows. Regional and local burrowing owl populations thus depend on ground squirrel populations, and in the absence of ground squirrels habitat soon becomes unsuitable for burrowing owls. The dominant reason for the decline of the Bay Area's burrowing owl populations is the encroachment of urban and agricultural development on their habitat. Burrowing owls are also adversely affected when ground squirrels and other burrowing mammals on which they depend disappear, which may reflect a number of causes.

No burrowing owl sightings have been documented in the salt marsh portions of the Recon Study Area, but there have been multiple sightings throughout the southern portion of the area. Sightings have been reported from urbanized landscape within the town of Alviso and from the surrounding grassland habitats. In recent years several pairs of burrowing owls formerly located south of Highway 237 have been displaced because of land development.

A.8.4.8 Loggerhead Shrike (Lanius ludovicianus)

The loggerhead shrike is a state species of concern. It is a predatory songbird that forages in grasslands, savannas, and ruderal habitats, feeding on small reptiles, mammals, birds, and insects. It nests in small trees or shrubs. In approximately the last 20 years, populations of the loggerhead shrike in eastern North America have declined significantly. Loggerhead shrikes are still considered fairly common in much of California, but the piecemeal loss of the state's grasslands may have contributed to local declines, and statewide populations of the species are declining somewhat.

Loggerhead shrikes are known to occur within and near the Recon Study Area. Shrikes breed in the Recon Study Area, and a nest with young was found in an isolated elderberry shrub east of the railroad tracks near the west bank of the Guadalupe River. They also use the areas north of Highway 237 for foraging (H.T. Harvey & Associates 1999b, 1999c).

A.8.4.9 Salt Marsh Common Yellowthroat (Geothlypis trichas sinuosa)

The salt marsh common yellowthroat is a state species of concern. It inhabits areas of emergent vegetation and breeds in fresh and brackish marshes in the San Francisco Bay Area from Marin County south to the Santa Clara-Santa Cruz county line. The breeding season is from mid-March through early August, and pairs frequently raise two clutches per year. Salt marsh common yellowthroat individuals cannot be reliably identified in the field. This subspecies can only be confirmed by observing nesting, because it is the only yellow-throat subspecies known to breed in the vicinity (H.T. Harvey & Associates 1999b, 1999c).

Salt marsh common yellowthroats have been documented from the Recon Study Area and its vicinity. They have been observed by SCVWD biologists in the lower reaches of the Guadalupe River, and by SFBBO biologists in Alviso Slough, along San Tomas Aquinas Creek, and along Coyote Creek and its associated marshes (SFBBO 1985, Padley 1997).

A.8.4.10 Alameda Song Sparrow (Melospiza melodia pusillula)

The Alameda song sparrow is a state species of concern. It is one of three song sparrow subspecies known to breed in the salt marshes of the San Francisco Bay Area. This species can be found in taller vegetation found along tidal sloughs, including cordgrass and marsh gumplant. Although it is occasionally found in bulrushes in brackish marshes, the Alameda song sparrow is a sedentary species; it is not known to disperse upstream into freshwater habitats. Populations of this species have declined because of the loss of salt marshes around the bay, although where suitable habitats exist, it is still very common.

SCVWD and H.T. Harvey & Associates biologists have observed breeding song sparrows throughout the Recon Study Area. However, it is extremely difficult to identify the different subspecies of *M. melodia*. Song sparrows breeding in the Recon Study Area may represent *M. m. pusillula, M. m. gouldii*, both races, or crossbreeds between the two races (Padley 1997, H.T. Harvey & Associates 1999b, 1999c).

A.8.4.11 Tricolored Blackbird (Agelaius tricolor)

The tricolored blackbird is a federal species of concern and a state species of special concern, and is listed as uncommon on the San Francisco Bay National Wildlife Refuge Bird Checklist. It lives in open valleys and foothills at low elevations, from southern Oregon through the Central Valley of California and south into Baja California. It is most abundant in the San Joaquin and Sacramento valleys. The tricolored blackbird breeds in cattail or tule marshes, and forages in fields, irrigated lands (including alfalfa and rice croplands), and stands of timber. It also nests in blackberry thickets.

The tricolored blackbird has been reported from the lower Guadalupe River corridor (Padley 2000). It is suspected to occur within the Recon Study Area.

A.8.4.12 Southwestern Pond Turtle (Clemmys marmorata pallida)

The southwestern pond turtle is a state species of concern. It is a riparian species but is known to nest as much as 500 meters from water, digging small nests in dry soil. Southwestern pond turtles are commonly found in still or slow-moving waters of streams, ponds, and lakes.

The southwestern pond turtle occurred historically along the Guadalupe River, although urban development and non-native predators such as bullfrogs, dogs, and non-native fish, have reduced or limited local pond turtle populations. Southwestern pond turtles have been observed on Coyote Creek and along the lower reaches of the Guadalupe River. They are unlikely to use the tidal portions of Guadalupe River or San Tomas Aquinas Creek because these streams lack sheltered lagoons where turtles would be protected from tidal surges. Southwestern pond turtles are not known to breed within the Recon Study Area.

A.8.4.13 Salt Marsh Harvest Mouse (Reithrodontomys raviventris)

The salt marsh harvest mouse is federally listed as endangered. It depends on stands of pickleweed in marsh habitats surrounding San Francisco Bay and is most abundant where deep, dense pickleweed provides non-submerged refugia during high winter tides (Shellhammer et al. 1982). Although this species makes some use of grasses and salt-tolerant forbs at the upper margins of salt and brackish marshes, it is closely tied to the cover of dense pickleweed, and makes little use of pure bulrush or cordgrass stands (Wondolleck et al. 1976, Shellhammer 1977). Salt marsh harvest mice inhabit both marshes that are open to tidal action and diked marshes, provided that suitable pickleweed habitat is present.

Several trapping studies have documented the presence of salt marsh harvest mice in pickleweed-dominated marshes in the Alviso area, such as New Chicago Marsh, and in areas along the southern margin of Coyote Creek that support pickleweed growth (e.g., Rice 1974, Zetterquist 1976, Muench 1985, Shellhammer et al. 1982, Shellhammer et al. 1985, H.T. Harvey & Associates 1990c). In some of the surveys, mice were captured sporadically (not during every trapping effort) and/or in low numbers. Nevertheless, this species has been captured fairly consistently in areas providing high-quality pickleweed habitat, and any such habitat in the Alviso area provides at least potentially suitable habitat. The marsh along the southern border of Coyote Creek was most recently surveyed for salt marsh harvest mice in 1990 (H.T. Harvey & Associates 1990b, 1990c, 1991a). These surveys demonstrated that salt marsh harvest mice are also present in the Coyote Creek area.

No trapping surveys for salt marsh harvest mice have been conducted along Alviso Slough or Guadalupe Slough. However, suitable habitat is present in pickleweed-dominated areas along the lower reaches of both sloughs, and the species is expected to be present in these areas. Along the middle and upper reaches of the sloughs, pickleweed is more sparsely distributed, and where present it is commonly restricted to a narrow, discontinuous band at the toe of the levee slope. This habitat is less suitable for salt marsh harvest mice, although dense and/or tall vegetation is present on the levee slopes along portions of the sloughs, providing refugia during high tides.

A.8.4.14 Other Listed Species

Other state- and federally listed species use habitats in the Recon Study Area, but are not resident or breeding populations (Table A-10).

A.9 CULTURAL RESOURCES

A.9.1 PREVIOUS STUDIES AND SURVEY COVERAGE

A records search was conducted for the Lower Guadalupe Recon Study Area on February 25, 2000, at the Northwest Information Center at Sonoma State University. The records search indicates that the area has been the focus of numerous cultural resources studies in the past. Because the Office of Historic Preservation recommends re-surveys every 10 years, only the studies and surveys conducted within the last 10 years are pertinent to this discussion (Banet and Rossa 1990; Banet and Yelding-Sloan 1992; Basin Research Associates 1995; Busby et al. 1996; Cartier et al. 1992; Holman 1992; Holson 1997; Laffey 1990; McLean et al. 1995; Speulda 1995; Woodward Clyde 1997). Figure A-8 shows the areas surveyed within the past 10 years.

A.9.2 KNOWN SITES AND SIGNIFICANCE STATUS

The records search identified thus far four resources within the project area. Figure A-8 shows their locations. Table A-11 presents each site number, along with a brief description of the site and its significance status in relation to the National Register of Historic Places (NRHP).

Table A-11. Known Historical/Cultural Resources in Study Area

Site Number	Description	Significance Status
CA-SCL-810-H	historic ship-building facility at Port of Alviso	recommended not eligible (Woodward Clyde 1997)
CA-SCL-339	Port of Alviso National Historic District	listed on NRHP (Office of Historic Preservation 1986)
CA-SCL-485	prehistoric bowl mortar and fire-cracked rocks	eligibility not known
CA-SCL-528	prehistoric midden with artifacts and human remains	potentially eligible for NRHP (Holman and Wiberg 1983)

A.9.3 COMPLIANCE REQUIREMENTS

A.9.3.1 California Environmental Quality Act (CEQA)

CEQA states that public or private projects financed or approved by public agencies must assess the effects of the project on cultural resources. Cultural resources are defined as buildings, sites, structures, or objects that may have historical, architectural, archaeological, cultural, or scientific importance.

CEQA requires that if a project results in significant effects on important cultural resources, then alternative plans or mitigation measures must be considered; however, only important cultural resources need to be addressed. Therefore, prior to the development of mitigation measures, the importance of cultural resources must be determined. The steps that are normally taken in a cultural resources investigation for CEQA compliance are as follows:

i. identify cultural resources;

ii. evaluate the significance of resources;

iii. evaluate the effects of a project on all resources; and

iv. develop and implement measures to mitigate the effects of the project only on significant resources.

A.9.3.2 Section 106 of the National Historic Preservation Act (NHPA)

This regulation requires that a federal agency must take into account the effects of a project on historic properties and afford the Advisory Council on Historic Preservation (ACHP) and other interested parties an opportunity to comment on these actions. If this project is considered a federal undertaking, the lead federal agency must comply with Section 106 of the NHPA. The Section 106 process has four basic steps:

i. identify and evaluate historic properties;

ii. assess the effects of the project on historic properties;

iii. consult with the State Historic Preservation Officer (SHPO) and other interested parties regarding adverse effects on historic properties, resulting in a Memorandum of Agreement (MOA); and

iv. proceed in accordance with the MOA.

A.9.4 RECOMMENDATIONS

To comply with either the California Environmental Quality Act or Section 106 of the NHPA, the SCVWD should follow these steps:

i. conduct a survey of areas that could be affected by the project that have not been surveyed within the last 10 years;

ii. record cultural resources identified as a result of Step 1 above;

iii. evaluate significance of cultural resources within the project area according to criteria of California Register of Historical Resources and National Register of Historic Places;

iv. determine whether the project will adversely affect a significant site;

v. in consultation with the State Historic Preservation Officer and other interested parties, develop mitigation measures for sites that will be impacted or affected; and

vi. implement and monitor mitigation measures.

A.10 RECREATION

This section describes existing recreation land uses and activities in the Recon Study Area. Figure A-9 shows recreation land uses and facilities in the reconnaissance study area. It addresses the following major uses, many of which are related to the U.S. Fish and Wildlife Service (USFWS) Don Edwards San Francisco Bay National Wildlife Refuge (SFBNWR):

- SFBNWR Environmental Education Center,
- SFBNWR New Chicago Marsh trail,
- SFBNWR Alviso Slough and Mallard Slough recreation trails,
- SFBNWR hunting,
- SFBNWR Drawbridge historic area,
- Alviso Marina County Park, and
- Alviso Park.

This section also includes a brief description of the following planned trails, portions of which already exist:

- San Francisco Bay Trail,
- Guadalupe Trail, and
- Coyote Creek/Llagas Creek Trail.

A.10.1 DON EDWARDS SAN FRANCISCO BAY NATIONAL WILDLIFE REFUGE

The SFBNWR was established by an act of Congress in 1972 to protect and manage habitat for migratory birds and endangered species and to provide environmental education and wildlife-dependent recreation opportunities. The Refuge consists primarily of marshlands, salt ponds and open water. The approved refuge boundary encompasses 43,000 acres in south San Francisco Bay, of which the USFWS actually owns 21,500 acres. Approximately half of the Recon Study Area is within the SFBNWR (Figure A-7). Recreation features are described below.

A.10.1.1 New Chicago Marsh and Environmental Education Center

In 1972 a portion of the 365-acre New Chicago Marsh became the first parcel of land to be purchased for the newly established Don Edwards SFBNWR. Portions of the marsh, primarily in the southwestern area, are still privately owned by several landowners and are designated "private open space" by the City of San Jose. The USFWS operates an environmental education center at the end of Grand Boulevard in the northeast corner of New Chicago Marsh (Figure A-7). The center provides information about the natural resources of the Don Edwards SFBNWR, including plant communities and wildlife, provides group education for students, and has meeting rooms and observation decks. The New Chicago Marsh Trail is a 0.6-mile loop consisting of boardwalk through the salt marsh and trail in upland areas.

A.10.1.2 Hunting

Waterfowl hunting is allowed in select areas on the wildlife refuge (see Figure A-7). The hunting season generally runs from mid-October to mid-January. The exact opening and closing dates change each year (Leong pers. comm.).

A.10.1.3 Knapp Parcel

The USFWS owns title to the 452-acre Knapp parcel, located south of Coyote Creek between Alviso Slough and Guadalupe Slough (Figure A-7). The parcel was formerly owned by the Cargill Salt Company and used in salt production as Pond A6. It was later used by a duck club, and has remained undeveloped open space for the last 5–10 years. The USFWS hopes to ultimately restore the land to tidal marsh (Kolar pers. comm.).

A.10.1.4 Drawbridge

Drawbridge is a small marshy island in the northern portion of the Recon Study Area (Figure A-7). People started coming to the area in 1876 for its excellent hunting and fishing. By the early 20th century, Drawbridge had become a full-time community with several resident families and a weekend resort for hunting and fishing. Railroad tracks originally laid by the South Pacific Coast Railroad established the location for the town's Main Street. By the 1940's, increasing urbanization in surrounding areas and pollution of San Francisco Bay reduced most of the island's sport fish and wildlife populations. Today, Drawbridge is a ghost town, and the cabins and other structures are sinking into the bay.

USFWS has previously given walking tours of Drawbridge, but will not do so in the future because of access issues. Although USFWS owns the property, Union Pacific Railroad now owns the tracks and the railroad right-of-way corridor. Because of liability risks associated with the subsidence of the island, Union Pacific does not permit access via its tracks (Bay Area Backroads web site, HYPERLINK http://www.bayareabackroads.com, and Kolar pers. comm.).

A.10.1.5 Recreation Trails

There are recreation trails within the SFBNWR along the levees between Alviso Slough and Mallard Slough/Artesian Slough (Figure A-7). These are under a separate section, "Recreation Trails," below.

A.10.2 ALVISO MARINA COUNTY PARK

The Alviso Marina is part of the Santa Clara County Parks system (Figure A-7). The 29-acre bayside park provides opportunities for picnicking and wildlife observation, as well as access to the public lands of Don Edwards SFBNWR for seasonal hiking and bicycling on the wildlife refuge's trails. Although Alviso Marina County Park no longer operates as a marina, it is possible to launch small watercraft at high tide. Facilities at the marina include picnic tables, parking, a boat launch ramp, and restrooms.

USFWS owns land east of the existing Alviso Marina County Park, between the levee and Alviso Slough. The USFWS is trading this property to Santa Clara County Parks in exchange for part of the salt ponds. The county plans to use the property for a boat launch and parking area (Kolar pers. comm.).

A.10.2.1 Other Marina Access

Another marina exists farther south on the east bank of Guadalupe Slough (Figure A-7). It is accessed from Alviso Village.

A.10.3 SUNNYVALE BAYLANDS PARK

The southernmost corner of the Recon Study Area is within Sunnyvale city limits and is part of the Sunnyvale Baylands Park wetlands restoration area. Operated by the City of Sunnyvale, this large county park includes picnic facilities and playground equipment, as well as natural wetland areas. The large rectangular pond in the park (and within the Recon Study Area) is an old dredge spoils basin that was used in the 1950s for depositing dredge spoils from Alviso Marina. Immediately south of the pond is a City of Sunnyvale water pumping station (Oliver pers. comm.).

A.10.4 RECREATION TRAILS

There are a number of recreational trails in the Recon Study Area. Figure A-10 shows recreation trails and pathways in the Alviso area. Regional trails in the area include the San Francisco Bay Trail and trails associated with Don Edwards SFBNWR. Sub-regional trails include pathways along both Coyote Creek and the Guadalupe River. These riparian trails are intended to traverse a major portion of the waterway, connecting several jurisdictions within the Coyote Creek and Guadalupe River watersheds. All of these trails are acknowledged in the San Jose 2020 General Plan (City of San Jose 1994a) and the County of Santa Clara's recently adopted Trails Master Plan (Santa Clara County Trails Plan Advisory Committee 1995). In most cases, these trails are intended for use by both hikers and bicyclists. Information on the trails was obtained from the Alviso Master Plan (City of San Jose 1998a) and from SFBNWR brochures.

A.10.4.1 Don Edwards San Francisco Bay National Wildlife Refuge Trails

Don Edwards SFBNWR contains several trails that provide access to the marshlands immediately north of Alviso. They extend primarily along the levees between Alviso Slough and Mallard Slough/Artesian Slough, and can be accessed at the Alviso Marina County Park or at the Environmental Education Center (Figure A-7). These unpaved trails are used for walking, bird-watching, and biking. The Mallard Slough Trail Loop, which begins at the Environmental Education Center, is 5.5 miles long and is open from September to mid-October and from mid-January to February 28; recreation in the Mallard Slough area is limited because the area is heavily used by breeding birds. The Alviso Slough Trail Loops, which begin at Alviso Marina, are 9 miles long and are open all year. Cargill Salt Company retains a lifetime lease to use the salt evaporation ponds and maintains the levees around the salt ponds, including the trail levees (Kolar and Leong pers. comm.).

A.10.4.2 San Francisco Bay Trail

The proposed San Francisco Bay Trail (Bay Trail) would be a 400-mile long trail around the perimeter of San Francisco and San Pablo bays. The trail would offer walkers, runners, cyclists, nature lovers, and hikers access to the bays and their diverse resources. In San Jose, a 5-mile segment of the Bay Trail would traverse Alviso, connecting Sunnyvale Baylands Park on the west with Alameda County on the east. The segment of the Bay Trail proposed to extend through Alviso is shown in Figure A-8. The Master Plan process for the Bay Trail is anticipated to be complete by December 2000. Segments already exist in several jurisdictions. Existing segments within the Recon Study Area include the paved pathway in the southern tip of the area, segments along Highway 237 from Sunnyvale Baylands Park to the northern extension of Great America Parkway, and segments within the SFBNWR (Slavit pers. comm.).

A.10.4.3 Guadalupe Trail

The Guadalupe Trail is a proposed sub-regional trail route that would follow the Guadalupe River levees from Alviso and ultimately extend south of the Guadalupe Reservoir in southernmost San Jose (Figure A-8), roughly paralleling the Guadalupe River. It is intended for hiking and off-road bicycle use.

A.10.4.4 Coyote Creek

The Coyote Creek Trail is another proposed sub-regional trail. It generally follows Coyote Creek from Alviso in the north to Anderson Lake in the south (Figure A-8).

A.10.4.5 Juan Bautista de Anza National Historic Trail (NHT)

This trail commemorates the route taken by Anza and other Spanish explorers during the 1700s. Through Alviso, it follows the alignment of the proposed San Francisco Bay Trail along the Guadalupe River and into the SFBNWR (Figure A-8) (Slavit pers. comm.). From Alviso, it continues north along Coyote Creek toward Milpitas and Fremont.

A.10.5 RECREATIONAL USES IN ALVISO VILLAGE

The 60-acre western portion of Alviso Village is listed as a Historic District on the National Register of Historic Places and is a California Point of Historic Interest (Figure A-7). The Historic District is discussed in greater detail in the Cultural Resources section of this report. Several historically significant structures in the area are used today, some for recreation-related uses. For example, the San Francisco Bay Bird Observatory (SFBBO) is located in the old Bay Side Cannery building at 1290 Hope Street (Figure A-8). The SFBBO is dedicated to the conservation of Bay Area birds through research, monitoring and education. SFBBO offers classes, field trips, bird walks and opportunities for volunteer fieldwork as a means of increasing knowledge and enjoyment of the Bay Area's birds (San Francisco Bay Bird Observatory 1999).

Alviso Village is home to other recreation facilities as well. Alviso Park is a 7.5-acre park located adjacent to George Mayne Elementary School. This city-owned park includes a swimming pool, a playground, and a baseball/soccer field. The South Bay Yacht Club, San Jose's only yacht club and associated harbor, is located at 1491 Hope Street (Figure A-8). In addition, the Pinhigh Golf Center is located on North First Street near Grand Boulevard. The golf center includes a driving range, bar and grill, pro shop, and offers golf instruction.

A.10.6 BICYCLE NETWORK

In October 1993, the San Jose City Council approved a Bicycle Master Plan establishing a citywide bicycle transportation network. The bicycle master plan provides for bicycle lanes and bicycle routes. A bicycle lane consists of a specially designated striped area on the roadway. A bicycle route has no painted lane, but is marked with signs indicating a shared roadway.

According to the Alviso Master Plan, Bicycle Network facilities already exist in some places and are planned or under construction for several other major streets in Alviso. City bicycle lanes enter Alviso along North First Street from Highway 237 and extend as far as Grand Boulevard. City bicycle routes then continue along Grand Boulevard to the Environmental Education Center, and along Taylor Street and Hope Street to Alviso Marina County Park. Another city bicycle route follows Gold Street from Highway 237 to Taylor Street (Figure A-8) (City of San Jose 1998a). However, field surveys in March 2000 indicate that there are no bike lanes or bike route signs on any of these roads. The only existing bike lane or route in the Recon Study Area is the paved pathway at the southern tip of the area, along the north side of Highway 237. This pathway ends at the Great America Parkway.

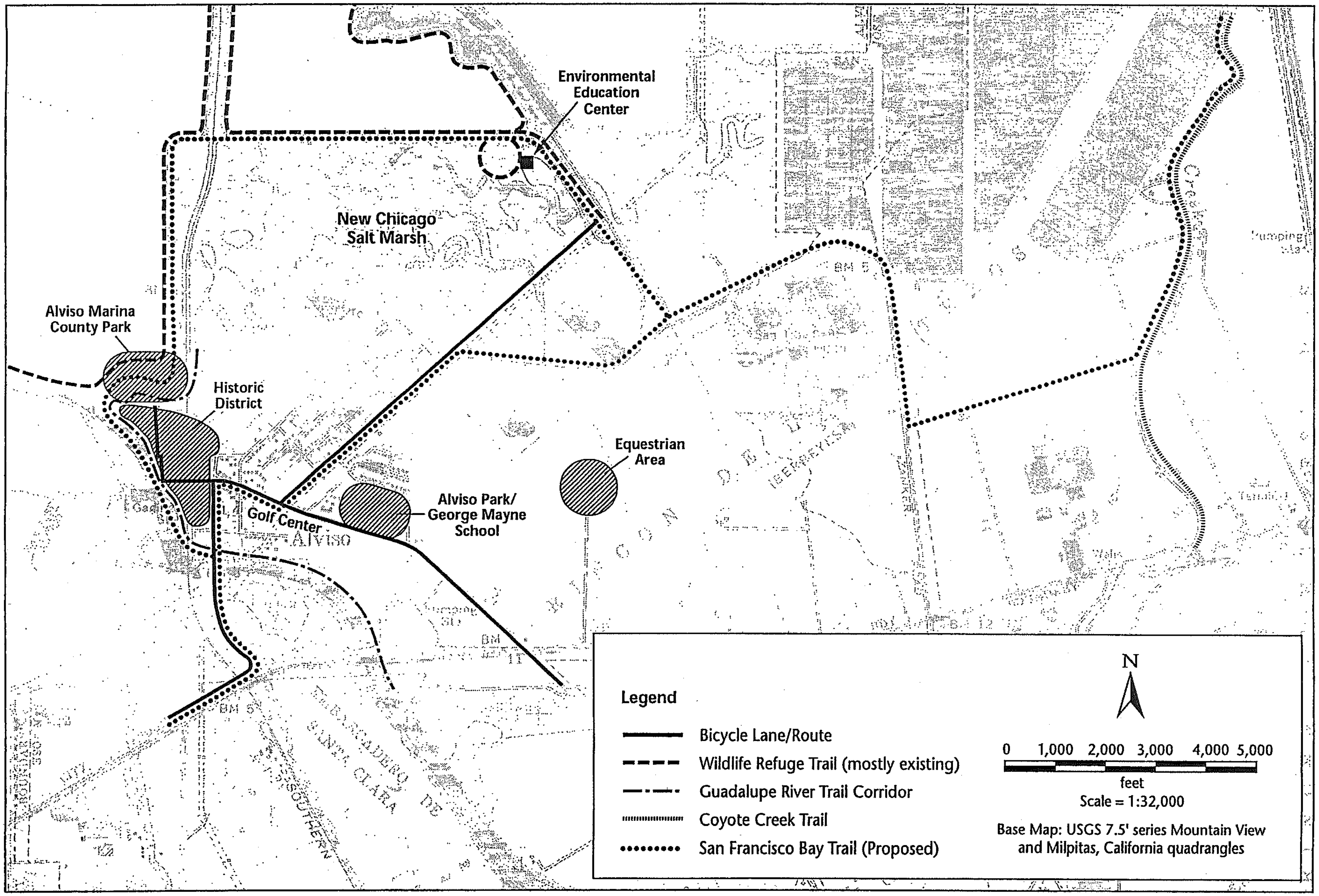

Figure A-10
Recreation Trails and Pathways in Alviso Area